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McGRAW-HILL PUBLISHING COMPANY, Inc.

SEPTEMBER 13, 1917

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ENGINEERING NEWS-RECORD

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Successful Bidding for a Large Tunnel

THAT competitive bidding of most successful character is possible despite the obstacles imposed by uncertainty of future labor and material costs is proved by the bids for the 18-mile Shandaken tunnel to supplement New York City's new Catskill water-supply. The figures are keenly competitive, with the lowest bid and the next only 2% apart. The specifications and contract form were of the type customary in the city's work. There were no new departures to help out the contractor, no provisions for covering his risk as to labor and material. It was straight unit-price bidding, relieved only by an unusually long time-allowance, namely, seven years. The city may well feel satisfied at securing such bids. The figures are high, but it is a time of high prices; and competent judges believe that there would be little prospect of better bidding for a long time after peace is declared.

Jersey City Moves To Clear Water-Supply Muddle

COMMENDATION is due the present authorities of Jersey City for taking action to clear up the long-muddled water-supply situation inherited from past administrations. The proposition for a trunk sewer and for activated-sludge and chlorination plants in the Rockaway valley is outlined on page 522. Prompt, positive and fearless action by Jersey City is certainly demanded after years of hesitation, vacillation and trying to shift the consequences of a loosely-drawn contract to the municipalities in the Rockaway valley and to make the State Department of Health its agent for the transfer.

An Interesting Question for the Court To Decide

TO COMMEND the Jersey City authorities for again taking up the trunk sewer project mentioned in the preceding paragraph does not mean that efforts to reopen the suit to compel the contractor to provide or pay for sewage diversion below the dam need be given up. The engineers whose perhaps excusably over-confident testimony in the very first days of a new art appears to have convinced the court that hypochlorite disinfection satisfied the contract requirement for works that should deliver pure and wholesome water have since publicly declared that they went too far. They and sanitarians generally now understand full well that chlorination is only a safeguard for doubtful water-supplies before other means of purification are provided. But can a case like this be reopened years afterward because of over-confidence by experts in the efficacy of a new process? The corporation counsel of Jersey City was instructed months ago to get an answer to this very question. Recently the question was referred to special counsel. Why not let the original court of jurisdiction—the Court of Chancery—decide? Meanwhile the trunk sewer plans may well be carried forward.

Macadam Roads Best for War Traffic

THERE are so many interesting features of the road maintenance work in the war zone of France, described by William J. Weir on page 488 of this issue, that it is difficult to single out any particular detail for comment. The thing that will probably interest United States highway engineers most is the almost universal dependence upon waterbound macadam to carry the heavy war traffic. When conditions are analyzed, however, this reversion to what can now almost be called one of the "early" types of pavement is not difficult to understand. True it is that the war-zone traffic is tremendous, both in volume and in weight, and practically continuous. Such conditions, in normal times, would immediately suggest to the highway engineer one of the so-called "permanent" surfaces—asphalt, brick, stone block, concrete or one of the numerous types of bituminous treatment. Waterbound macadam is about the last thing he would consider. But war sets up new standards, and so far as highways are concerned the chief of these is the necessity for continuous maintenance work *under traffic*. The motor trucks must be kept moving and road-maintenance work must shift for itself. Obviously these considerations at once eliminate any pavement whose repair would mean an interruption to traffic—even for a very brief time—and so they narrow the choice to waterbound macadam roads. The maintenance methods on these routes, Mr. Weir tells us, are of the most primitive kind—the mere throwing on of new stone between the passage of one vehicle and the next. Yet the object sought is accomplished, for the compacting of this new material under the steady stream of heavy motors is, of course, almost instantaneous.

Thus the war, so far as roads are concerned, has led us around in a circle, starting with the waterbound macadam of a generation ago, proceeding through the many types of bituminous, block and concrete surfaces, and back again to waterbound macadam. War's demands have made the cycle complete.

Will Canada's Latest Move Help Her Railroad Situation?

WHAT from this distance looks to be a step directly away from a solution of Canada's railway problem has been made by her Parliament, in the decision to buy the Canadian Northern Ry. and make a large loan to the Grank Trunk Pacific Ry. In spite of a wide range in the recommendations of the majority and minority of the Royal Commission and the unofficial investigators of the matter, there was common agreement on one point—that the Canadian Northern and the Grand Trunk, each strong where the other was weak, should be made to dovetail into one system. In the face of all this expert advice the Dominion Government, panic-stricken at the urgency of the situation, votes to throw a large additional sum of money into the sinkhole of unprofitable competition. Unless all of the experts are wrong, the government cannot operate the Canadian Northern at a profit without extensive construction in Grand Trunk territory, nor will the $7,500,000 voted to the Grand Trunk Pacific make much of a start to the feeder system that road must have in Canadian Northern territory.

The United States has no railway problem quite comparable to this. Yet the railroad situation as a whole is serious enough to merit the most earnest consideration. Doctrines have for years been at large and acquiring strength that might plunge us into worse difficulties than Canada is struggling with. It behooves us not to wait until the case is acute before making a careful study of it, nor to allow ourselves to be stampeded by inexpert public opinion.

Distribution by Team, Truck and Railroad at the Camps

TEAMS for one, motor trucks for another, railroads for a third—but each of the cantonment jobs got there. To the building contractor, it is an enigma that any man can wait, when there is pressing work to be done, to lay railroad tracks or "fool around" with miles of mule teams, nose to tail, each carrying but a small load. It is equally mysterious to the railroad contractor, accustomed to open spaces where the road he builds furnishes the only modern means of transportation in the district, that the building contractor can afford to chug around in hub-deep sand or mud with one of those "condemned abominations" that can't run a hundred yards without sticking in a mud hole or breaking down.

The truth of the matter is that, when the right kind is furnished, these "abominations" will surprise the railroad man, even when run through mud and sand; that mule teams, though each hauls but a small load, can move an unconscionable quantity of lumber when massed in sufficient numbers; that a little advance preparation in the way of quickly-laid spur tracks may keep the gangs going under weather and road conditions that sorely try both the patience of the mule and the stamina of the motor truck.

There is no doubt that the five-ton trucks of the weightiest known construction with which the army truck companies sent to some of the camps are equipped can be easily out-distanced in sand or mud by the less powerful but lighter mule. The rear chain sprockets of some of these trucks, clearing the ground by scant inches, contribute to their downfall. There is also no doubt that an endless double file of teams and wagons is more subject to blockade and more expensive per ton-mile than the right kind of light, strong truck, even perhaps on bad roads. Neither is there any denying, where grading can be avoided, that a quickly-built track, thrown into the work by logging-road methods, offers a sure, rapid and almost weather-proof line of communication between the receiving yard and the center of building operations. Therefore, the description of how these diverse methods were applied in the army cantonment work, which appears on other pages of this issue, should be read without prejudice and with due regard to the conditions at each cantonment.

The Council Makes Its Statement

THE Engineering Council's first public statement apprises engineers of a new movement it has under way for the benefit of the profession. Dr. Hollis' remarks show tendencies toward a farreaching progressivism. He—and doubtless the entire Council shares the views uttered by its official spokesman—aims at some leaguing of engineering societies such that the entire profession can speak with one voice.

This far-extending body is not to discuss technical subjects, if we understand the situation rightly. Existing societies are not to be disturbed or their organizations or functions touched. Non-technical matters only are to be taken up in this general Council.

So much is sure. But nothing has been told as to what particular class of questions is to be dealt with. In other words, what is to be the precise field of operation of the Council? Only one item has been brought forward so far; a classified list of the nation's engineers is to be drawn up, containing all personal data as to professional qualifications. In the first instance, this list is to be for the use of the Government, but it will doubtless serve wider purposes in the end.

Two or three meetings of the Council have been reported. The deliberations at these meetings contain nothing that would add to the above. Nothing further has been made known that would furnish a physical expression of the idea which the Council may embody.

The Council exists, but up to the present it has not yet justified itself. Large bodies move slowly—there

are many ways of saying that patience is needed in looking for results in a big matter. It can be argued that four or five months' time is not enough for the Council to come forward and say what and why it is.

But in the opinion of *Engineering News-Record* the movement which the Council may represent is far too weighty, too vital to the interests of every engineer for anything but the most prompt and speedy action. Temporizing and slow deliberation are not appropriate to the times or to the case. In this pressing and hurrying year, an agency that rises up to bring unity to a profession seriously in need of it has the clear duty of making its appeal at once; of presenting its credentials, stating its purpose and rallying all to its standard. The Council has failed of this duty.

In this failure—up to now—we believe the Council has seriously fallen short of realizing its opportunities and has measurably jeopardized its chance of engaging the support and sympathies of the profession. It may be that resolute action in the immediate future can retrieve this loss. Such action, if it also answers the challenge as to democratic origin and constitution which was earlier raised by a correspondent in our columns, can lay the foundation for most fruitful development. We earnestly hope that this may be accomplished.

High Bids or Low Estimates?

THE DIFFICULTY of getting lump-sum or unit-price bids on public work is getting to be so common that San Francisco's recent failure to let its new aqueduct tunnel because the only bid received was nowhere near the engineer's estimate will scarcely excite so much remark as if it had occurred three years ago. Nevertheless this notable instance, in which the only complete bid submitted for the entire work was more than 46% above the estimated cost, forcibly emphasizes the question of whether contractors are bidding too high or engineers are estimating too low. While it is not desirable that contractors should become frightened into making exorbitant estimates on work which will last for some time into the future and which must by law be contracted for at an inelastic price, neither is it desirable for engineers to charge contractors with such action unless the engineers are sure that their own estimates make due allowance for the increased cost of work and the increased liability to hazards which cannot be predicted.

While it is not possible to pass a sound opinion on the merits of the San Francisco case without an independent estimate, made by competent parties, nevertheless some comparisons with the Catskill Aqueduct costs will be of interest and will emphasize to engineers the unusual importance which attaches at the present time to careful estimates of the cost of public work.

The Catskill Aqueduct was driven almost entirely in hard, igneous rock, while it is understood that the San Francisco tunnel is located in sedimentary formations, largely sandstone. There may also be some differences in the requirements of lining, while certain sections of the Catskill Aqueduct are of somewhat larger diameter than the Hetch Hetchy tunnel. In the main, however, the two projects are comparable, especially as considerably higher material and labor prices rule today on the Pacific Coast than governed the bids which were submitted some years ago for the New York City work.

The city tunnel of the Catskill Aqueduct, about equal in length to the San Francisco tunnel, was let at a price in the neighborhood of $100 a foot for driving and lining the tunnel alone. The bid also included further large items for some 3000 ft. of shaft work. As this work was done first, there is little doubt that the unit prices quoted for it carried the greater proportion of the contractor's overhead and plant charges, since it is common practice to relieve the interest burden on large work of this kind by including these charges in the prices for the first items to be paid for.

The entire bid on the Hetch Hetchy project, including plant, overhead and all other items, is reported as about $95 per foot. One important item, the supply of power, will doubtless be lower than on the aqueduct work, as it is to be furnished by the city. Moreover, the city tunnel of the Catskill Aqueduct required a great deal of trucking and the shafts were far apart, whereas the San Francisco tunnel is in open country and there is more opportunity to arrange the work for greater construction economy. To offset this, however, the contractors for the Catskill Aqueduct, except in one or two cases, ran no risk of encountering bad ground. In the more recent and softer formations to be encountered in the California project, this contingency may assume serious proportions. It might be added, in case the city tunnel is held to be an unfair section of the Catskill Aqueduct for comparison, that contract prices on the upstate pressure tunnel were about the same figure.

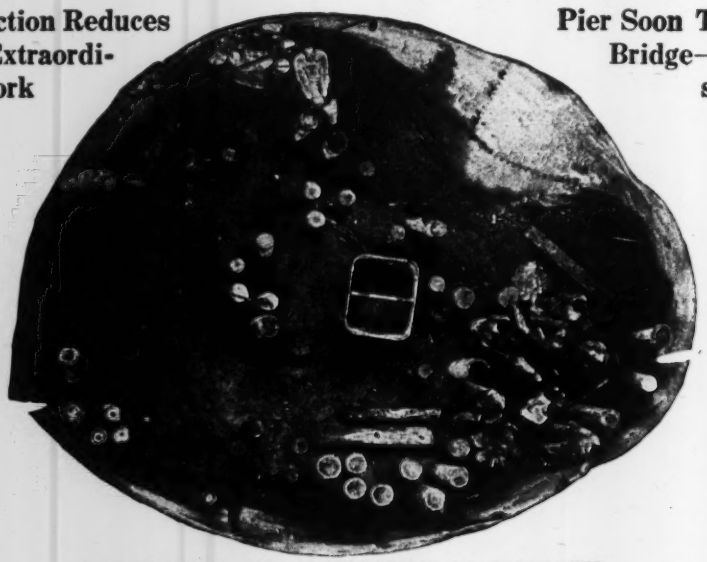
It is true that labor conditions on the Pacific Coast have made it extremely risky for contractors not already possessing an organization in that territory to undertake work of such magnitude, thus limiting competition on this work. Also, contractors are often twitted by their associates and spoken slightingly of by engineers on the ground that their experience with one job of a given type leads them to bid high on the next one that is offered. R. C. Storrie & Co., the only firm to submit a bid for the entire work at San Francisco, has just completed the Twin Peaks traffic tunnel. However this may be, it is equally true that an engineer's reputation may survive an incorrect estimate, while a contractor's bank account cannot.

As these lines go to press, a further comparison presents itself in the bid figures for the new Shandaken tunnel of the Catskill system, just announced. With close and eager competition, the lowest bid is not far from $130 per foot of tunnel. The work is closely comparable with the San Francisco job. If the conclusion is drawn that an engineer of Mr. O'Shaughnessy's standing has been led into the error of too low an estimate for present conditions, other public-works engineers may find it well to check up their figures.

Defective Foundation Causes Failure of Pier

Accident in Construction Reduces Area of Footing—Extraordinarily Defective Work

Pier Soon Tilts and Endangers Bridge—Successful Reconstruction Completed



UNCOVERING OLD FOUNDATION IN COLLAPSED SHELL—NOTE IRREGULAR SPACING OF PILES

LESS than two years after its construction the pivot pier of a large swing-bridge in Arkansas began to tilt to one side, and threatened to cause destruction of the bridge. In one night it tilted no less than 9 in. Nothing could be done to save the pier, and the bridge was supported on falsework to permit of wrecking the pier and building a new one in its place. When the old foundation was reached it disclosed an amazing piece of defective work, which had been covered up in the original construction.

The Martin free bridge across the Ouachita River, near Camden, Ark., built in 1913, has a 290-ft. through-truss draw span, and two 51-ft. pony-truss shore spans. The pivot pier was 60 ft. high; the lower 22 ft. was to be 27 ft. in diameter (built in a steel shell), and the upper part 24 ft. in diameter. The intermediate piers were pairs of 66-in. riveted cylinders filled with concrete and connected by horizontal channels. These piers were 60 ft. high, with five 30-ft. piles driven in each cylinder.

Early in 1915, an overturning and settling tendency of the pivot pier was discovered, and the State Highway Engineer, H. R. Carter, advised the authorities of Ouachita County to have an investigation made by an engineer. In June, 1915, the county employed I. A. Baum, consulting engineer, of Camden, Arkansas.

Defects and First Plan of Repair

Daily level readings during June and July showed that the pier was tilting at the rate of 0.02 ft. per week, the general direction being upstream and about 30° towards the left bank. The total movement from the vertical on Aug. 1, 1915, was 9 in. The river fell in September and on the night of Sept. 16 the pier tilted 9 in., making a total of 18 in.

The concrete above the water line was found to be of inferior quality, and to be in layers for each day's work, the layers being separated by ½ in. to 2 in. of laitance. Soundings showed scour of about 7 ft. on the upstream side and 4 ft. on the side opposite the left bank, but none on the downstream side or opposite the right bank. A large cavity was found in the upstream side of the pier, beginning at 10 ft. below the existing water level (or about 38 ft. below the top of the pier) and extending into the pier at about 45°. The high stage of water and a cluster of piles on this side of the pier made it impossible to measure this cavity accurately. The outline of the pier below normal water line and just above the cavity was found to be irregular and elliptical.

The existence of this cavity was explained by the fact that the concrete in the lower part of the pier was of such poor quality that it crumbled away when the river bed was scoured. It was learned that the concrete for the base of the pier was permitted to drop through the entire depth of water inside the casing. The aggregate also consisted of sand and gravel dredged from the river and used without regard to proportion or condition.

The first report made by Mr. Baum recommended surrounding the pier footing with a reinforced-concrete jacket, 35 ft. diameter, resting on two rings of piles; this to be built within a cofferdam of interlocking sheet piling which would be left in place as a protection against future scour. The pivot pier was to be underpinned with concrete as much as possible. The county authorities then (July, 1915) engaged C. D. Purdon, Chief Engineer of the St. Louis Southwestern Ry., to make an examination. His report agreed in general with Mr. Baum's recommendations. However, the sudden increase in tilting on Sept. 16, noted above, made this jacketing impracticable. It was decided, therefore, to wreck the old pier and build a new one.

For this reconstruction, the drawspan was supported on two timber towers, built on either side of the pier, and the turntable and operating machinery were re-

moved. Obstruction of the channel was done by permission of the War Department.

The report of Mr. Baum states that above low water the pier was of fairly hard concrete, but in layers 6 in. to 36 in. thick, separated by ½ in. to 2 in. of laitance. Below the water line the material resembled loose sand and gravel with layers and pockets of laitance as much as

FOUNDATION PILE IS DRIVEN THROUGH COLLAPSED SHELL FOR FOOTING ON BRIDGE PIER

18 in. thick. At 3 ft. above the top of the footing (and its steel casing) 23 piles were found, and at the level of the top of the footing 42 more piles were disclosed. Many of these last were simply poles.

The piles had been driven in clusters on the left and downstream sides, owing to the collapsed condition of the pier on the other sides (as noted below). The original plan called for 135 piles 35 ft. long, driven to a depth of 24 ft. below the base of the footing, the material around their tops to be removed to a depth of 11 ft. and the space filled with concrete. Some of the piles were so short that they were embedded in the footing for their full length. Only one pile penetrated as much as 13 ft. below the footing. For many of them the penetration was only 18 in., and the average for all the 65 piles was only 7 ft. The driving of the new piles to 25 ft. penetration showed that the requirements of the original plan could have been obtained.

Area of Pier Reduced More Than 50%

The most extraordinary discovery, however, was a reduction in area of the pier due to a collapse of the steel shell around the footing. The normal horizontal area of the footing was about 575 sq.ft., but its area at the extreme bottom was reduced to 221 sq.ft. The lower part of the shell had collapsed on all four sides: On the upstream side this began at 5½ ft. below the top of the casing and extended 11 ft. inward; downstream side, at 11 ft. from the top and 4 ft. inward; right side, at 10 ft. from the top and for 10 ft. inward; left side, at 10 ft. from the top and extending 2½ ft. into the pier.

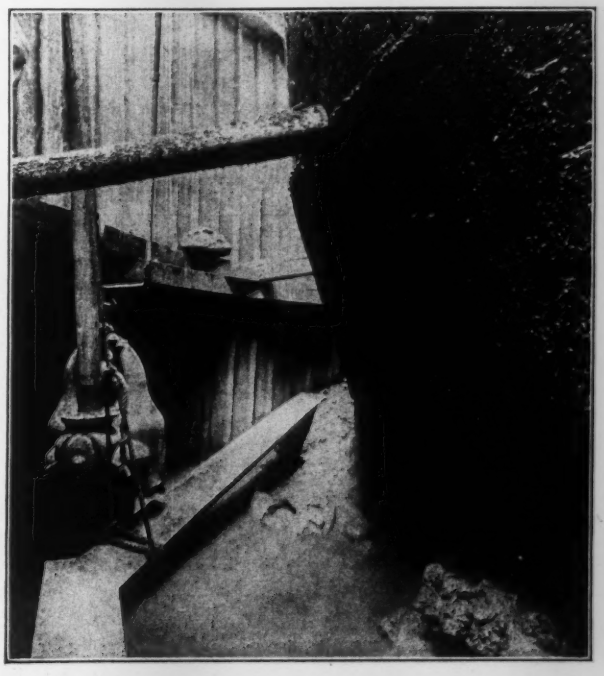
As if this was not enough, one pile was found to be driven through the horizontal seam of the collapsed shell, at 11 ft. below the top of the footing, on the downstream side. In a report made at Mr. Baum's request by C. E. Smith, consulting engineer, of St. Louis, it is stated that the collapse evidently occurred in sinking the shell. It reduced the base area by about 50%, and made it impossible to drive the required number of piles.

Mr. Smith states that his experience in bridge building indicates conclusively that as soon as the collapse occurred the condition must have been known, and that the attempt was made to cover up the defective work by driving piles through the steel casing. This is indicated by the heavy iron point or nosing iron found on the work. This was evidently made for the purpose of punching holes through the steel casing so piles could be driven through it. However, only one pile was found thus driven.

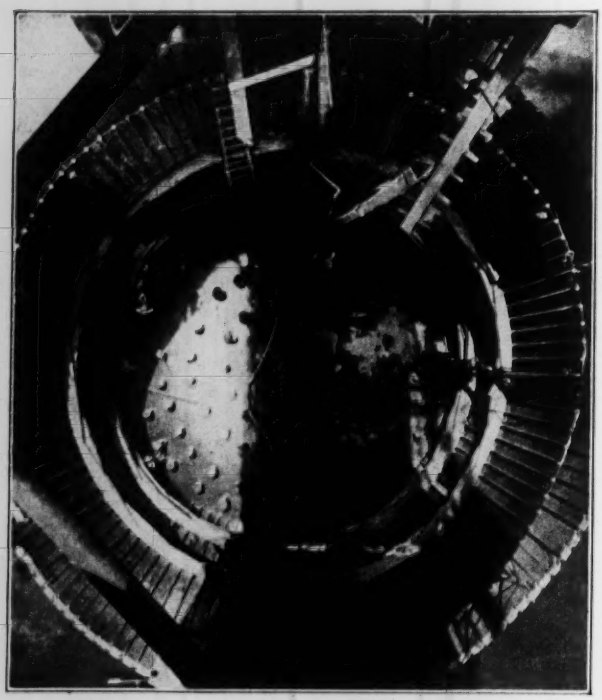
Foundation Concrete That Was Not Concrete

The original specifications provided that concrete placed under water "must not be allowed to fall into place, but must be lowered in vessels to the dumping place and deposited in a compact mass."

Mr. Smith stated that the material forming the footing of the pier had not been placed according to the specifications and could not be classed as concrete. While probably mixed in proper proportions, the materials had separated to such an extent that instead of a mass of homogeneous concrete there was a heterogeneous series of layers of gravel, sand and laitance. The gravel



COLLAPSED SHELL OF FOOTING OF OUACHITA RIVER BRIDGE PIER



BASE OF NEW FOOTING IN UNBRACED STEEL COFFERDAM. NOTE CAREFUL SPACING OF PILES

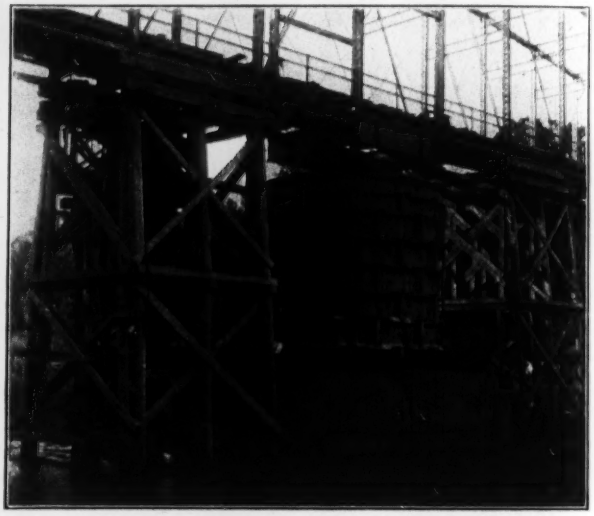
and sand could be removed with a shovel, indicating the entire absence of cement in these layers. Between these were layers of cemented material having the color and texture of chalk. "Although there is more of this material than I have ever before seen in concrete, it is quite evident that it is laitance."

Evidently the concrete was allowed to fall from some point above the water surface. The sand and gravel were washed clean and settled according to their weight. The cement was retained in the water, and kept agitated until the work stopped at night. Then it gradually settled to the bottom. But by that time it had lost much of its cementing property.

The total dead load of the old pier and superstructure was about 1618 tons. Assuming a safe load of 1.5 tons per sq.ft., the bearing power for the actual base area of 221 sq.ft. was only 331 tons. The bearing power of the 65 piles could hardly be considered of any value due to their uneven distribution and lack of penetration. However, taking into consideration the fact that the unit penetration of the piles for the new pier was about 3 in. per blow when their total penetration was equal to the average penetration of the old piles, the bearing power of the latter could be assumed at 4½ tons per pile, and their total bearing power would be 282 tons, or a combined total of 613 tons. Thus there was a deficiency of about 1000 tons in bearing power of the pier foundation. Mr. Baum points out that the pier was doomed to failure in view of the above, without taking into consideration the eccentricity of loading.

The weight of the new pier and superstructure (with reduction for buoyancy) is about 2068 tons. The bearing power is about 1613 tons for the base (at 1½ tons per sq.ft.) and 1456 tons for 104 piles (at 14 tons each). This gives a total of 3369 tons, or 1000 tons in excess of the load.

A cofferdam, 37 ft. in diameter, was built of United States interlocking steel sheetpiles, 50 ft. in length.



FORM PLACED FOR NEW PIER INSIDE COFFERDAM—SWING BRIDGE SUPPORTED ON FALSEWORK

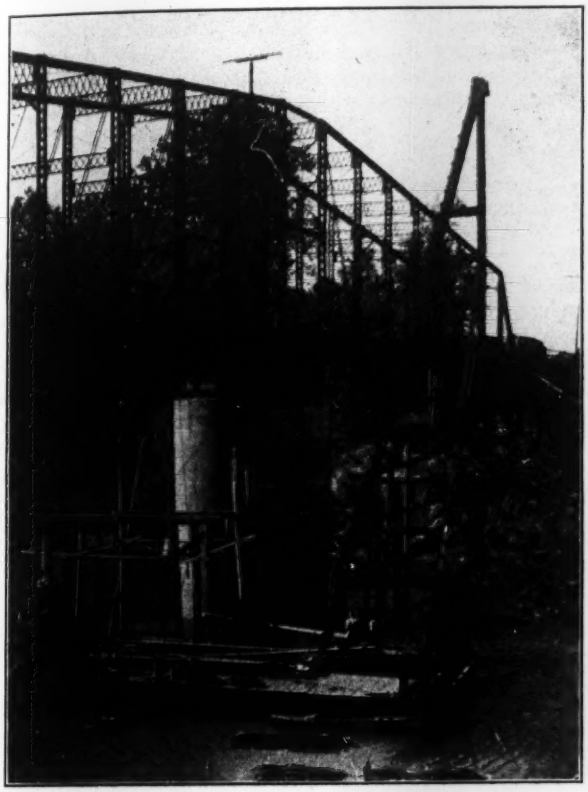
BASE OF OLD FOUNDATION IS LESS THAN 50% OF INTENDED AREA

This was set up around a guide wale and driven by a No. 2 Vulcan steam hammer suspended from the boom of the derrick barge. When the entire circle was assembled and closed, each pile in turn was driven to full depth. Outside of this was a cofferdam 45 ft. diameter composed of Wakefield sheet piling in lengths of 32 ft. for the upstream side (on account of the scour) and 28 ft. for the downstream side. A puddle of local clay was placed betwen the two rings of sheeting.

Although the cofferdam was 37 ft. interior diameter, no cross-bracing was used. Four rings of circular waling were built, each composed of two thicknesses of 6 x 12-in segments. Against the waling was driven the outer row of foundation piles 3½ ft. c.to.c. Another row was driven 2½ ft. inside, each pair of piles being on the same radial line. Struts were placed between the rows and between the piles of each row. These piles were 10 ft. longer than the other foundation piles, and

were not cut off until part of the concrete had been placed. The unobstructed open pit greatly facilitated the work of driving the inner piles, placing the concrete and building the upper forms.

The 104 foundation piles were driven in five rings, 3½ ft. to 16½ ft. radius, and spaced 3 ft. and 3½ ft. c. to c.



TILTING OF PIVOT PIER MADE IT NECESSARY TO BEGIN EXTENSIVE REPAIRS

The average penetration was 17 ft. below the bottom of the pier, and each pile was driven to refusal by the steam hammer swung from the derrick boom. The cut-off was 6 ft. above the bottom of the concrete. The top 19 ft. of the steel sheeting was cut off with an oxyacetylene torch, leaving the lower part in place as a permanent protection extending 23 ft. below the base of the concrete.

Excavation was done by hand, the material being shoveled into the concreting buckets. The new concrete was a 1:2:4 mix. Sand and gravel were excavated from the river bed by a floating derrick with orangepeel bucket, which then dumped it again into the water (to wash it) beneath a cableway operating a clamshell bucket. This dumped the material onto a platform, from which it was shoveled into buckets and hoisted by the derrick to the mixer.

The concrete mixer was placed on falsework as near the cofferdam as possible and at about the level of the bridge floor. The cement was stored in a shed near this and wheeled to the mixer. The concrete was spouted directly from the mixer to the cofferdam, which was kept entirely free from water. At 2 ft. from the base, about three tons of steel rails were laid in the concrete. The steel cofferdam served as the form for the lower part of the pier. Above this the form was of 2 x 6-in. vertical lagging nailed against circular ribs made of two thicknesses of 4 x 12-in. planks, in segments, these ribs being about 3½ ft. c.toc. At the end of each day's work a key 6 ft. square and 1 ft. high was built in the center of the pier.

The upper part of the old pivot pier was wrecked by exploding dynamite charges in holes made with churn drills. The masses of concrete were loaded onto a barge by a derrick, and were used later as rip-rap around the new pier. The old concrete below low water was handled easily by pick and shovel, without blasting.

Floating Plant

The floating plant consisted of a barge 28 x 60 ft., with a stiffleg derrick (60-ft. boom) at one end and a pile driver at the other end. The latter had leads 70 ft. long, in three sections, so as to facilitate the work under the bridge. The falsework towers carrying the superstructure during this work, consisted of pile bents below surmounted by framed bents. They were made in this way so that the piles could be driven with the pile driver at the sides of the bridge, as the driving of long piles from the floor would have delayed traffic.

The building of the new pier and replacing of the turntable was completed on Sept. 1, 1916. The cost was $42,000, exclusive of the wrecking of the old pier. The reconstruction was done by the Midland Bridge Co., of Kansas City, Mo.

Information as to this extraordinary case of defective work and its reconstruction, has been furnished by I. A. Baum (now a member of the La Salle Engineering Co., Chicago), who was called in to investigate the conditions. He made the designs for the new work, and was in direct charge of the removal of the old pier and the construction of the new foundations and pier.

Worcester Buries Fish Offal

Fish offal is buried by the City of Worcester, Mass., with sanitary precautions. The service is independent of the garbage piggery described by Prof. Frederic Bonnet, Jr., on page 396 of our issue of Aug. 30.

An average of about 1.1 tons of fish offal is collected daily and is disposed of by dumping in a hollow and covering with loam. This material, during the fly season, comes thickly seeded with fly eggs and even larvæ, chiefly of the green bottle variety. Before dumping, the ground is prepared by first removing the top soil which is mixed with and finally covers the material. This allows the bacteria of the soil to destroy the material aërobically, with but little odor.

In order to prevent swarms of flies developing, box fly traps, baited with fish heads, are set around the edges of the dump and the composted pile is sprayed each morning with a mixture of 3 parts kerosene and 1 part turpentine or some creosote spray, which very effectively kills the flies which emerge from the compost. The scrap is not dumped in the same place on two succeeding days but at some other place in the hollow, and the same place does not again receive scrap for six months or more, after which time all the material has been thoroughly disintegrated. This dump is surrounded by woods, which help to diffuse any odor likely to be present during the summer months.

Road Maintenance in the War Zone of France

As Observed by a U. S. Highway Engineer Driving an American Ambulance

By WILLIAM J. WEIR

American highway engineers who have been speculating as to the methods of road repair and maintenance on the Western Front, where traffic has been enormous ever since the war began, will find in this article answers to many of their queries. The author, William J. Weir, served on the engineering staff of the United States Office of Public Roads, under Director Logan Waller Page, before he went to France as a driver in the American Ambulance Corps. The facts reported, therefore, are based upon the observations of a technically trained observer. Nothing of the sort has heretofore appeared in print in this country, as far as we are aware. Mr. Weir submitted his material in the form of a report to Mr. Page, to whom *Engineering News-Record* is indebted for permission to use the following:

IT WAS in the Somme sector that I found things moving at highest tension and the transportation system most severely taxed. Here there was an immense volume of traffic moving in the entire area 20 miles back of the line; destructive artillery fire within the 5-km. zone; continuous heavy fighting that demanded great movements of troops, supplies and ammunition; and the necessity for the accommodation of an advancing army over ground that has hardly a spot untouched by shells.

The original layout of the French system of highways was fortunately most comprehensive. It has filled the requirements of the present exaggerated demands in a most admirable way and has undoubtedly been a tremendous factor in the defense against the German invasion. New roads have, of course, been constructed under special local conditions, but these instances seem to be rare and, in the main, the original highways, unchanged in location, grade, or width carry the war traffic.

Safety Roads

New roads are constructed mainly to relieve traffic from shell fire. On the eastern end of the line, among the hills, roads are often built to the "leeward" of the enemy. A specific instance of this is in the Argonne Forest, near Four de Paris. The main concentration of reserves, supply stations, dressing stations, etc., is in a long narrow valley a few hundred yards back of and parallel to the first line trenches which are on the other side of a low hill range. The original road was on the far side of the valley and is in sight and easy range of the enemy. It is marked "Very Dangerous" on army maps. An entirely new road has been built in the shelter of the hill range, hugging it closely in all the deviations of the slope. Here traffic can move in almost full security from direct hits.

Main roads are well known to the enemy and their range established by experience. In the flatter country, they often run on tangents miles in length making easy targets. In heavy actions, these roads are so vigorously shelled that supply trains cannot pass except with severe losses. As a counter measure, new roads are sometimes built near-by—crooked in alignment but in general direction paralleling the main road. Traffic is shifted between these roads to avoid shell fire or to confuse enemy airmen as to which line is actually being depended upon for service.

The French plan of troop cantonments, supply stations, base hospitals, etc., is quite evidently designed with the road facilities as a basis. It is a rare thing to find heavier traffic moving than the width of road can accommodate except, of course, on the main trunks near the first line where congestion is unavoidable; this case will be discussed later. Each class of road from the grand highways to the little community roads, seems, in a busy sector, to have just that portion of the traffic which it can satisfactorily handle. This condition is too general to be accidental, and as the result of careful planning of concentration points and the routing of movements it is admirable and a great credit to the French engineers.

Temporary concentration camps for large bodies of troops, as we know them here, are practically unknown in the war zone. Tents, except for hospital uses, are rarely seen. Troops are quartered in villages, the houses of which are entirely commandeered for the purpose. Each house, public building and stable carries a card showing the number of men it can shelter. Troops move out and new men come in, in the same day, without confusion. This system is of special advantage from the transportation engineer's standpoint for it obviates the necessity for special camp roads; does away with the transportation of cumbersome camp equipment; and keeps men and materials concentrated on existing highways and village streets.

Traffic Divided Between Many Roads

When a division moves to a new point, different units of the division may be ordered to move on different routes. Marching troops are slow moving and tend to obstruct motor traffic on the main roads; side roads are better suited for them. Light motor ambulances can take a longer route, using secondary roads. Horse-drawn supply wagons can take rough side roads which have been allowed to get in bad condition. Heavy motor trucks, with low gasoline mileage and costly to repair, must have the best roads and the direct route. In such movements, each unit is given its routing; it may or may not be designed to prevent congestion accordingly as the necessity exists. But the general scheme is there ready for use and it is made possible by the

minute network of roads of all classes in the French system.

All crossroads and road junctions are plainly and permanently marked with distances and directions to neighboring points. This has proved an invaluable aid to effective movements of units in charge of officers the great majority of whom are strangers in the particular locality. I cannot conceive of all the divergent movements of the present war being put through without the aid of these road signs, except with endless confusion and delay. On the other hand, they must be of similar aid to the enemy in the occupied territory. It would be an excellent plan in any retreat, or in time of invasion to have men especially detailed to destroy all road signs before the retirement.

Traffic

At certain points and at certain times in the war zone, the volume of traffic, of course, exceeds all limits of peace times. It combines all elements of destruction to the road surface which it uses. It is continuous and urgent. It cannot be halted for careful repairs or maintenance work to restore the road surface; yet the surface must be kept in a fair traveling condition. Travel must go on in the rainy season when the surface is softened and holes rapidly deepened by displacement of mud; and in dry summer, when the binder flies out in clouds and constant raveling occurs.

Traffic is made up of all varieties: Cavalry (very little); horse-drawn wagons and batteries with steel-tired wheels; troops with hob-nailed shoes; heavy motor trucks; and fast motor automobiles. It seemed that heavy motor trucks made up fully 50% of the traffic on the main roads. It will be seen, from our American standards, that continuous traffic of the above nature institutes as severe a test of a wearing surface as can be imagined.

The road leading from Amiens to the front lines of the Peronne-Chaulnes sector, is a good example of extreme concentration of traffic on a main feeder of a busy front. From Proyart to the front—a distance of about 9 miles—the bulk of the traffic must move at night, incidentally without lights, to avoid observation by the enemy. From Amiens to Proyart, it moves principally in the day time. In both instances it is practically continuous, four solid lines of vehicles move

New roads are constructed mainly to relieve traffic from shell fire. Traffic is shifted between these roads and the old routes to avoid shell fire and confuse enemy airmen.

in almost continuous procession. slow moving horse-drawn vehicles hug the shoulders of the roadway, leaving the center for motor travel. Fleets of motor trucks pound steadily by in hundreds, spaced only about 50 ft. apart and traveling at an average rate of at least 12 miles an hour.

All convoys, or fleets of vehicles, move in a formation which provides an open space of 100 to 200 ft. or more after a group of several vehicles. Certain vehicles in the convoy carry a large red disk about a foot in diameter to indicate to the driver following that he is to leave space. This is to expedite the passage of fast moving units such as officers' cars, dispatch cars, or ambulances, which would otherwise be forced to proceed at the speed of the convoy. Even with four lines moving, an open space several feet in width is usually maintained in the center. Independent units move in this, dropping into convoy spaces to permit the passage of other independents going in the opposite direction.

Cavalry and batteries are sometimes forced by traffic demands to move through the fields bordering on the roadway. It is quite common to see long stretches of main road where the effective width has been increased by what is practically an earth road on either side. Troops on the march are sometimes shunted to side, secondary or even temporary roads when the jam is great, and roadside signs indicating where this may

On the main feeders to the front four solid lines of vehicles move in almost continuous procession.

be done are frequent. These expedients are necessary to the proper movement of wheeled traffic when a main trunk leading to a busy sector is reached. As a result, this enormous traffic moves with a smoothness that is amazing.

Altogether, it is difficult to understand how any system of roads could handle traffic of such volume, continuity and destructive qualities. That it is being done in France indicates that there are lessons to be learned there by the highway engineering forces of all other nations. The various factors that make this feat possible are worthy of deep study and investigation which the nature of my army service made it impossible to give.

Type of Roads

The prevailing type of road in northern France is the waterbound macadam. Many gravel roads were also seen and a very few roads in the Marne Valley were found to be of a local chalky material. The latter were wholly minor roads. Except for the cobble and block streets of some of the villages, no bituminous macadam, concrete, brick or any of our American so-called permanent types of construction were encountered.

The waterbound macadam type lends itself extremely well to the demands of war conditions. Material can often be found at roadside or locally, thus relieving the transportation system; maintenance and repairs can be conducted in the rough manner necessary to keeping roadways open, and with unskilled labor and without special equipment. The severe test of this type would of course come in the summer, when the wear due to loss of binder in the wind and to raveling must be very great. Unfortunately, I was not in the war zone during that period and so cannot judge. I saw these roads in the early fall, however, and they seemed to be in what I could afterwards estimate as average good condition.

One is inclined to wonder just what would happen to our bituminous highway surfaces, to our 6-in. concrete, or to our brick construction if these were subjected to the continuous pounding of traffic such as

Water-bound macadam, the prevailing type of road in northern France, lends itself extremely well to the demands of war. Except for cobble and block streets in some villages, no bituminous macadam, concrete, brick or any of our American so-called permanent types of construction were encountered.

occurs, for instance, on the Amiens road. They would develop severe weakness, of course; no standard surface would withstand such wear. I believe that the difficulties in repairing them in kind would be enormous owing to the absolute lack of time for necessary refinements. Modern war traffic over our standard country highways would undoubtedly bring serious problems of maintenance and repair.

General Maintenance and Repair

The system of maintenance and repairs to road surfaces in the war zone might be summed up in the phrase "do the best you can while you can." Work of this nature, in its true sense, cannot be performed with traffic demanding all of the roadway continuously. Makeshifts and rough work must be resorted to; such repairs as are possible must be made. When, and as soon as, the shifting of the point of big actions permits, complete repair and restoration of the road must be undertaken. It seems to be the French policy to keep all the important roads in best possible shape against the time when they must be used unsparingly, unmercifully and without adequate repairs. No effort to accomplish this is neglected. In no other way can the excellent service given be explained.

To illustrate: On the eastern end of the line there was comparative quiet last winter. The big actions in the Argonne and around Verdun were over. They had unquestionably brought enormous destruction to the roads in these sectors. The Bar-le-Duc—Verdun road, about 50 miles in length, had carried, during the months of the attack on Verdun, a continuous chain of about 5000 motor trucks night and day. The total wear and depreciation of the surface must have been terrific. But I found this road, and the other main roads of these sectors, in excellent condition, with smooth surfaces, full cross-section, clean waterways and with plentiful rock supply stored on the sides—in short, to all purposes, as good as new. Quite evidently, these roads had been repaired and thoroughly renewed without loss of time immediately after traffic congestion ceased. They are now as ready as they can be made to withstand the strain of another great traffic concentration should it come, and it may come any time. This is true preparedness; the result no doubt of the old French thoroughness in road construction and maintenance, combined with the lesson of experience in the importance of serviceable roads to effective army operations. Its results are remarkable especially when one considers the demands for labor and materials for purely offensive and defensive operations.

The worst roads are encountered very near the front, in an active sector. The artillery fire of the enemy within, say, 5 km. of the front line, is very destructive to the roads and, in a great measure, prevents effective repair work. This is particularly true in the Somme sector, where the country is flat and practically treeless, and so without protection to the roads or the traffic moving on them. Most of the time the enemy fire is directed on the roads and batteries in the zone from 2 km. to 4 km. back of the line. Here, too, the entire area was swept with creeping barrage fire during the Allied offensive and advance. Roads were destroyed and there has been no opportunity to rebuild them in good shape. It is a fact, therefore, that even the main road is in very rough condition after one advances beyond the position of the French first line trenches before the offensive; that is, in recaptured territory. Ambulances, for instance, are obliged to run largely in low gear from this point to and from the advanced dressing stations. The roads are passable but extremely rough. In this sector, too, upkeep of roads within about 2 km. of the front line is not attempted. Their position is too exposed and the shelling too severe. No vehicles approach the front beyond this limit, except the small "soup kitchens" and light supply wagons, and these only at night.

Details of Maintenance and Repair

My study of the details of maintenance and repair was of necessity confined to what I could see by chance in passing along the highways on service runs. It was never possible to stop for discussion with the officials in charge or to examine the work closely. Often, however, I passed a single piece of work so frequently that I became fairly familiar with it. I was able to pick up some information from officers in cantonments, which, coupled with actual observation, gave me such knowledge of the system as I here present. It is obvious, however, that this discussion cannot go deeply into this very interesting subject. But, with these reservations, the statements are, I think, true to fact.

The Bar-le-Duc—Verdun road, about 50 miles in length, had carried during the months of the attack on Verdun, a chain of about 5000 motor trucks, night and day.

The work very naturally divides itself into the more or less continuous addition of new material without interruption or real displacement of traffic, which can be called maintenance; and the renewal of the wearing surface completely, or repair.

Maintenance—The pre-war continuous patrol of road surfaces by individual cantonniers is not in evidence in the war zone. It is of course unnecessary to keep surfaces in the degree of excellence obtained in peace times. The little roadside houses of the cantonnier are now abandoned or used for storing tools. Maintenance, in the war sense, is practiced principally on the more important roads carrying heavy traffic. Two methods are in use:

1. Loose stone is placed by hand (shovels) in the surface depressions and compacted by traffic. The work is done at periods when the traffic is lightest. Usually the stone has to be placed hastily and in a rough man-

ter. Sometimes it must be cast entirely from the sides. Compaction takes place very quickly under passing fleets of heavy motor trucks with solid double 4-in. rear tires. In the continuous wet weather that was the rule last winter, the results were surprisingly good.

2. The surface is first roughly cleaned of excess mud. Working in short periods, whenever traffic permits, layers of material about one stone thick, are placed in narrow, longitudinal strips and rolled into the surface with steam rollers. The resulting surface in this, as in the first method, is irregular and rather rough but the main object, which is to restore sufficient material to maintain full thickness, is accomplished.

Repair—Repairs to main trunks in busy sectors are not attempted, except for the filling of shell holes. Material must be supplied by the methods above described and repairs postponed until such time as traffic will permit.

Building stones and brick from villages destroyed by shell fire is an interesting source of road material.

Surfaces are renewed by the half-section plan of operation. The old surface is scarified by hand and stone added to the desired thickness. Earth and clay seem to be freely used to expedite quick binding. The new surface is compacted with steam rollers.

Rock Supply

Rock supply is often brought in by rail. Usually, though, there seemed to be a local source within wagon haul. The rock is broken by hand either at the quarry or at roadside. Supply piles are kept stacked at roadside for maintenance and repair.

Building stone from villages demolished by shell fire is another interesting source of road material. Stone is so generally used in the construction of French villages that in many cases a large amount of material convenient to the location of the work can be obtained in this manner. In the Somme sector one of our advanced posts was a dugout at the crossroads which had once been the center of the village of Estrees. Originally it was 2 km. long and had a population of about 1500. I was amazed at the completeness with which it had been destroyed; there was hardly a sign of the buildings that must have stood there, not a wall or a portion of a wall standing. I soon learned that the underlying reason was that building stone had been carried away for road purposes.

Brick is also obtained from ruined buildings for road purposes. I saw an interesting and original type of surface reconstruction in the vicinity of the big base hospital at Marcelcave. A 3-in. course of brick bats, salvaged in this way, mixed with a small percentage of crushed stone, compacted with a steam roller, was used. The finished surface was quite smooth and looked like a red clay road of our South. Wet weather continued during the time this surface was under my observation. Under this favorable condition, it was an excellent road. It was probably recognized as a temporary expedient and will be in some manner strengthened to withstand dry summer weather.

Fighting men are not used for road work. All road work is done by men over the military age, by prisoners of war and by Anamites. Prisoners of war may not be, and are not, worked within the fire zone; that is in ordinary range of their own guns. Manual labor on the roads is also optional with them and they are paid therefor. Great numbers of them may be seen at maintenance and repair work however.

The Anamites are soldiers of Chinese appearance from the French province of Anam in Asia. They do not, I understand, believe in warfare and are used for guard duty well back of the lines and are apparently the main source of road labor. In winter, they are largely employed in clearing roadways of snow and scraping from the surfaces the mud which collects in enormous quantities.

General Conditions

As stated in the beginning of this paper, my work by good fortune carried me over many hundred miles of roads of all classes in the war zone. The average condition of these roads was far better than, under the circumstances, I expected. The first and second class highways are kept in relatively excellent condition. The community roads have, in very many cases, gotten into rather bad shape. They are often extremely rough with big holes, but they are hard surfaced and carry their traffic with safety from miring, if without comfort. This neglect of minor roads at certain points is evidently deliberate. It is true economy that decides it. These roads are used almost entirely by horse-drawn vehicles which are not seriously handicapped or damaged by them; in their ordinary use, speed is not essential; the distance traveled over them in reaching a second- or first-class road from the particular village is always short. The labor and materials necessary to their upkeep can be expended with greater effectiveness on the main roads. It comes back to our own policy and basis in the design of American road systems: 80% of the traffic on 20% of the roads; and I think that the ratio in favor of the concentration of effort on main trunks is even more marked under the peculiar requirements of war traffic.

It is evident that the French road system has made good. Its basic theory was certainly sound.

Conclusion

It is evident that the French road system has made good. I can not conceive of any road system in the world designed without knowledge of the present demands meeting the situation as well; indeed, it almost seems that the French system must have been planned for just the present conditions. Its basic theory was certainly sound. The following features of its design have proved of special advantage at this time of crisis when so much depended on its carrying the war traffic efficiently, without delay or confusion, and with economy of effort:

Grade—The prevailing grades are very easy permitting heavy loads for horse-drawn vehicles and faster

speeds for motor convoys. Location lines are found to follow contours in almost all cases. This has made for easier maintenance and easier rebuilding after destruction.

Drainage—The drainage systems, surface, side and sub-drainage seemed to be practically perfect. Outside villages I do not recall a single instance of poor drainage on a first- or second-class road. This has been a considerable factor in giving durability under the war traffic.

Foundation—Without adequate foundations, the main roads would have long ago completely failed. Maintenance, care or addition of surface rock could not have saved them. But these roads, even the worst community roads, stay solid and traffic does not mire or stick in soft stretches of broken subbase soils. This is one of the great lessons driven home; good foundation and adequate thickness of pavement.

Width—Width of traveling surface has been most important to army transport. Some of the grand highways, main feeders to the front, have a width of about 33 ft. between shoulders. Even this is crowded to capacity most of the time. How great a factor these widths have been to the success of the French army cannot be estimated nor can we guess the difference in offensive and defensive results, if they had been, say, the 18-ft. American standard.

High Ratio of Road Mileage—The landscape of France is a veritable network of roads. The number of miles of road per square mile of territory must be at least double, probably more, that in the United States. Inasmuch as these are all improved roads this has been of great service to army movements. Between two given points several routes may be selected, none of which will greatly exceed the most direct route in distance. To aid in the understanding of the continual large movements in the war zone, I should have perhaps explained earlier that divisions are constantly shifting location from one sector of the front to another; from the rear of the war zone to the actual front; in very active sectors, a particular division may be in the trenches only a few days, two weeks is said to be the average. It is this feature, sometimes overlooked, combined with demands for munitions and supplies, which accounts for the great burden of traffic these roads must bear. The dispersion of travel over different routes, made possible by the high mileage ratio, is therefore another great advantage of the French plan.

Road Signs—The military advantages of this feature have been discussed; they have depended on the fact that the work was done comprehensively, accurately and for permanence.

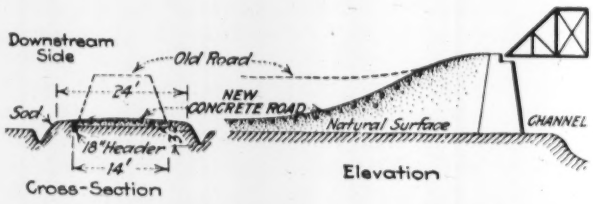
Maintenance—The general type, water-bound macadam, has proved itself well suited to special maintenance requirements of war conditions. Surfaces requiring prior mixing, careful laying, special equipment or time for setting would have been a source of great difficulty. It is also probable that the French habit of thorough maintenance, developed and held to consistently for many years by French highway engineers, has much to do with their success in meeting this extraordinary situation.

In conclusion, I must state again my realization that I have covered this field only very superficially. While in the war zone I lost no opportunity to gain information on the subject but my limitations were that my movements were restricted by my duties and military regulations, and I was not able to get in contact with officials who have direction of road engineering. Again, it is a field worthy of deepest investigation by American highway engineers, now while the war goes on; if for no reason than that here one can observe the action of road surfaces under traffic of intensity that anticipates the possible future developments along some of our main trunks; and for the study of this example of high efficiency in the engineering of transportation.

Overflow Road Approach to Bridge Instead of Old Fill

Use of Reinforced-Concrete Pavement at Low Level Prevents Water Being Backed Up During Floods

IN MANY Middle Western rivers where low banks allow high water to extend far back from the channel, it has long been the custom to build bridge approaches on low-gradient fills reaching back beyond the high-water area. Such fills formed in effect dikes too narrow on top for safe travel, making an effective dam or barrier which piled up the flood waters. Often the water would not be restrained and would wash out the fill, thus putting the crossing out of service for a time. In Putnam County, Ohio, the county engineer, P. T. Ford, some years ago began building low-level approaches to bridges over such rivers, the idea being to let the high water pass over the approach, which was built of such material and so designed as not to be damaged by an overflow.



OLD HIGH APPROACH TO LOW BANK RIVER BRIDGE IS CHANGED TO OVERFLOW SECTION

The drawing shows a typical crossing before and after lowering. The earth in the old approach is spread out sidewise so as to make a road of ample width. The pavement for the length subject to overflows is of concrete, reinforced with ½-in. longitudinal rods spaced 2 ft. c. to c. and with ⅜-in. transverse rods spaced 18 in. c. to c. There are no expansion joints, but on the downstream edge of the road there is a concrete toe-wall or header, 18 in. deep, to prevent washing back under the pavement. A tough sod is grown on the short downstream slope to protect the fill against overflow cutting.

Observations on the flood height of streams are made, and the new roadway fill is made high enough so that vehicles using it during normal high water will be about to the hubs in water.

Two structures of this type have been built now about four years, during which time they have been overflowed about ten times.

No Promise of Lucrative Practice Made to Engineering Students

Schools Report Marked Demand for Young Graduates in All Branches and Some General Increases of Pay, But Few Teachers Have Visions of a High-Paying Profession

IN CONNECTION with a study of conditions among the engineering schools of the country, just made by *Engineering News-Record*, an effort was made to size up the present demand for engineers as disclosed through the contact of alumni with deans or professors, and to find what support there existed for statements that "engineering was everywhere going to be the most lucrative of professions," recently circulated in an effort to increase the attendance at engineering schools.

Four questions were put to the deans and professors along this line:

(*a*) What demands do you experience for graduates in civil, mechanical, electrical, chemical and miscellaneous groups?

(*b*) Can you see any dearth or over-supply of engineers in any of the larger groups?

(*c*) Have you seen any field where war has temporarily or permanently taken an appreciable proportion of engineers engaged therein?

(*d*) Do you know of sufficient cases of improvement in the status and pay of engineers to support the view that engineering is soon to be the most lucrative of professions?

The replies in general show a strong demand for young graduates, but no startling dearth of engineers and little or no support for the view that engineering was expected to be particularly rich in financial reward.

Notable care was obviously given to most of the replies to these questions, and the more illuminating statements are reprinted in abbreviated form.

Response of Educators

A. W. RICHTER, dean of engineering, University of Montana—(*a*) Our graduates in mechanical, electrical, civil, and mechanical engineering are all at work. We have more inquiries than graduates. It has been necessary for us to look for an instructor in engineering, and there are very few candidates as compared to previous years. Deans of other engineering colleges inform me that they find it difficult to fill their positions.

E. E. HASKELL, dean of civil engineering, Cornell University—(*a*) The demand for graduates has been and continues to be very heavy. We are nowhere near able to meet it.

G. C. ANTHONY, dean of engineering, Tufts College—(*a*) The demand for graduate students in all departments of engineering has been unusually great. (*b*) It is not unlikely that there will be a real dearth of engineers in the immediate future. There is certainly no danger of an oversupply. (*d*) I have seen some evidence of an improvement in the status and pay of engineers, and I feel quite sure that it is soon to become a lucrative profession.

A. A. HAAMERSCHLAG, director, Carnegie Institute of Technology—(*a*) The demand for our graduates far exceeds the supply. There are remunerative opportunities awaiting our graduates in all fields. (*b*) The dearth of engineers will be in direct proportion to the number who are killed or incapacitated in the armies of the world. There is no chance of an over-supply. (*c*) In the field of mechanical engineering and metallurgy the losses are destined to be most heavy, since modern warfare is subjecting to an overstrain those engaged in that field. (*d*) It must be evident that the industrial reconstruction subsequent to the war will put the trained minds of engineers in a pre-eminent position. With a scarce supply and an extensive demand, men of this profession are destined to reap unusual rewards.

C. E. FERRIS, dean of engineering, University of Tennessee—(*a*) Very heavy demands for all classes, but particularly for mechanical engineers. (*b*) Supply not at all equal to the demand. (*c*) There is a shortage, particularly in mechanical engineers. (*d*) I foresee great work for engineers when the war is over.

Law of Supply and Demand Will Operate

C. S. NICHOLS, assistant to dean of engineering, Iowa State College—(*a*) This year and last we had several times as many calls as we had men to supply. Now we find employers endeavoring to retain the services of sophomores and juniors beyond the opening of college work because of difficulty in securing men for their places. (*b*) and (*c*) There appears really to be a dearth of engineers, particularly in chemical and civil engineering. The large numbers who will go into the Signal and Quartermaster Corps will very materially reduce the supply of electrical and mechanical engineers. The small enrollment for years past in mining engineering has left a shortage of men with this training which will be keenly felt after the war, when we may reasonably expect a great increase in mining operations to replace metals exhausted for war uses. (*d*) It seems reasonable that the law of supply and demand will operate within a very few years to make the engineer much in demand. There must result a very great improvement in the status and pay of engineers.

O. V. P. STOUT, dean of engineering, University of Nebraska—(*a*) The demand for the younger men has for more than a year been acute and beyond our power to supply. We have met only a small proportion of the calls which have come to us. (*b*) A simple negative would not be far from the truth if we have in mind professional engineers only. (*d*) Although I do not believe we are warranted in advancing such a doubtful statement, I do believe that we can, without the least scruple, undertake to secure the largest possible num-

ber of qualified students of engineering. The obligation will rest on us, however, to point out the limitations of the professional field and the limitations of many students, and to urge that a considerable majority of them seek their opportunity outside.

A. A. TITSWORTH, dean of engineering, Rutgers College—(*a*) A demand we cannot fill; unusual. (*b*) In civil engineering particularly. (*c*) In civil engineering; probably in all others. (*d*) Certainly a decided increase in pay, but not to the extent suggested.

NO DEARTH AND NO OVERSUPPLY

H. S. DRINKER, president, Lehigh University—(*a*) The demand for graduates is about normal. (*b*) No dearth and no over-supply seen. (*c*) I think that the establishment of the army engineer reserve has taken a considerable proportion of civil engineers for army service. (*d*) To anticipate that engineering is soon to be the most lucrative of professions is a little over-sanguine. There is no doubt that conditions prevailing in the last few years have resulted in increased demand for engineering graduates, and higher pay.

C. L. MEES, president, Rose Polytechnic Institute—(*a*) There seems to be a very great demand for graduates in civil, mechanical, electrical and chemical engineering, as we have had applications from many concerns and have been unable to secure men. All of our graduates have been placed, and a number of the January graduates have been spoken for. (*b*) It is too early to make a fair estimate, but from present indications there is a likelihood of being a larger lack of engineers in railroad service than in any other division. (*c*) It is too early to make an estimate. (*d*) No definite data at hand, but it seems likely that in the period of reconstruction immediately following the war there will be a larger demand for engineers, which, however, may not involve a very great increase in pay.

W. C. BAUER, acting director of engineering, Northwestern University—(*a*) More demands for graduates in mechanical, civil, electrical engineering than we can supply. (*b*) Yes. (*c*) All fields appear to be alike. (*d*) No.

ALFRED BOYD, dean of engineering, Oklahoma Agricultural and Mechanical College—(*a*) We would have no difficulty in placing several times as many graduates in engineering as we have this year. Apparently there is a dearth, due to abnormal conditions. I do not believe this situation is permanent. (*c*) War apparently has taken an appreciable number of engineers engaged in construction or in industries closely allied with military operations. (*d*) I have not sufficient evidence of increase in remuneration to support such a statement. An increased demand for engineers, however, should necessarily improve their status.

DEARTH IN CHEMICAL LINES

H. S. BOARDMAN, dean of engineering, University of Maine—(*a*) During the past three or four months there has been a steady increase in the demand for our graduates in mechanical, civil, electrical, and chemical engineering, and chemistry. I have never had in my fourteen years' connection with the university so few requests from graduates for assistance and so many requests from employers for men. (*b*) Our experience seems to point to a dearth of men along chemical lines. We have lost seven of our faculty in the department of chemistry and we are experiencing difficulty in replacing them. (*c*) Electrical engineering appears to have suffered the most. (*d*) I know of many cases of improvement in the status and pay of engineers which have come about from war conditions. Whether or not this is temporary or permanent is debatable.

J. G. SCRUGHAM, dean of engineering, University of Nevada—(*a*) The demand for engineers, more particularly civil engineers, exceeds that of any period in the history of the state. (*d*) The average salary being paid to engineers in this state has probably increased about 20% during the past year.

IN RAILWAY WORK SALARIES ARE LOW

C. H. BENJAMIN, dean of engineering, Purdue University—(*a*) The demand for engineering graduates the past season has been phenomenal. We have had positions for many more men than are available. This was true even before the era of enlistment further complicated the situation. We do not pretend to supply men for vacancies unless the situation is exceptionally promising. (*b*) It seems to me that at present there are not enough engineers to go around. This is due to the war and will become normal a year or two after the war closes. (*c*) I should say that there was a good demand for engineers of all kinds in the Officers' Reserve and training camps. Our difficulty is to hold back enough of our faculty to carry on our work satisfactorily. Some of our men are also in battalions of engineers already in France on railroad construction. (*d*) Except in railroad work, the outlook is good. There the salaries are low. The average income of graduates employed in the engineering departments of railways is about $1750 as against $2400 in manufacturing and $3200 in construction work. We hear complaints from railway managers that graduates do not stay. The reason is apparent.

H. V. CARPENTER, dean of mechanic arts and engineering, State College of Washington—(*a*) The opportunities for graduates in all of our engineering courses we have found to be unusually good this year, and there is a somewhat better rate of pay. One of our men was offered sixteen different positions before he finally went into an engineering training camp. (*b*) This would seem to indicate a shortage of men, although I do not know of any engineering work that has been seriously delayed through lack of engineers to handle it. (*c*) I think a little calculation will show that the demands of the war will not take any appreciable percentage of engineers into the field, but of course the productive side of the war, the manufacturing, will cause a very decided demand, which will undoubtedly cause a shortage or has already done so. (*d*) I should judge that in the Northwest at present engineers are being paid from 20 to 35% more for a given piece of work than before the war. We hope that this means a permanent improvement in the status of the engineer, but I would not care to be quoted as saying that the profession is likely to become at once the most lucrative.

JOHN E. HILL, Brown University—(*a*) The demand for graduates in the various engineering groups at present seems to be about normal, with a possible

tendency toward increase. (*b*) The supply of engineers at present seems to be normal. (*c*) Except from the standpoint of aviation, the various engineering fields seem to be normal. (*d*) Although the present pay is materially more than it was ten or fifteen years ago, I do not believe that engineering at present is as lucrative as law or medicine.

Large Returns Due to Exceptional Abilities

Ira N. Hollis, president, Worcester Polytechnic Institute—(*a*) We have so great a demand for graduates in all departments that we cannot supply them. They go into government service and into all kinds of industrial establishments. The demand for chemical men has increased our class very materially. (*b*) I cannot observe any over-supply of engineers, but I think there will be some readjustment after this war is over. Graduates will be coming back and there may be an over-supply. At present the dearth of supply is almost entirely in the junior positions. (*c*) It seems to me that this war has taken into civilian positions connected with the army or navy a large number of mechanical engineers, and that it has taken a number of civil engineers into the army, but I think it was comparatively easy to spare them. (*d*) Statistics from graduates show that pay averages as well as that in other professions, and the advancement in pay is about as good. There are exceptional cases in law, medicine and engineering where men get large returns, but it is mainly due to exceptional abilities. I do not think that engineering will soon be the most lucrative of professions, but I think that engineers will be properly paid in the future.

C. S. Howe, president, Case School of Applied Science—(*a*) Enormous demand for graduates. (*b*) No signs of any lack of demand for engineers. There will be no over-supply. (*c*) No dearth as yet, but if the war continues mechanical and electrical engineers will be in very great demand. (*d*) I hope the time will come when engineering will be the most lucrative of all professions, but fear I shall not live to see it.

Status of Engineer Will Stand Improvement

A. A. Potter, dean of engineering, Kansas State Agricultural College—(*a*) The demand has been great for electrical and mechanical engineers, but the demand for civil engineers, architects and graduates from other engineering courses does not in any way compare with that for those two. (*b*) Our observations indicate that there is an insufficient supply at the present time of mechanical and electrical engineers for the minor positions in the industries. We have not had many requests for men to fill positions which pay salaries above $2500 per year. We have had many requests for men to fill positions which pay from $75 to $150 per month. (*c*) The large manufacturing concerns seem to be short of men for the minor technical positions. (*d*) I do not believe that there is a basis for the statement that engineering will soon be the most lucrative of professions. My observations during fifteen years as an engineer and a teacher of engineering indicate that the status of the engineer in various industries would stand considerable improvement.

G. W. Bissell, dean of engineering, Michigan Agricultural College—(*a*) At the present moment the most notable demand for technical men that comes to this office is for teachers in technical schools. (*b*) A comparison of the situation this summer and last indicates no material change in the demand for men. In both seasons all of our graduates were placed without difficulty. (*d*) I would not be justified in claiming that the future of engineering as a profession is to be promoted by the expectation of its being strikingly lucrative.

C. E. Hewitt, dean of engineering, New Hampshire College—(*a*) We have been able to place all of our graduates in mechanical, electrical and chemical engineering (we do not have a civil-engineering course). We could place more first-class men at a fair salary if we had them. (*b*) My observation indicates that there are plenty of opportunities for first-class men, but perhaps there is a dearth of men who graduate from engineering schools who are barely above the passing requirements. (*c*) Aviation work has taken a large number of engineers, and apparently there is a good field in this class and also in the Signal Corps. (*d*) I do not actually know of many cases to support this view, but I am fully convinced that this ought to be the case and perhaps is one of the things to be looked for as a result of this war.

Thirty Applications for a Professorship

G. F. Blessing, professor of engineering, Swarthmore College—(*a*) All engineering graduates of Swarthmore College are, so far as I know, satisfactorily employed. I have not been able to supply men for vacancies brought to my attention. (*c*) It may be of interest to note that I received over thirty applications for positions here as assistant professor of civil engineering, and not a single applicant for an opening as shop instructor. All the civil-engineer applicants had had teaching and some had good practical experience. They were thrown out of employment by larger universities cutting down their instructing force in the higher branches and in specialized courses. (*d*) No, though I have heard the sentiment freely expressed.

A. B. McDaniel, professor of civil engineering, Union University—(*a*) We have a constantly increasing demand for both civil and electrical engineers with varying amounts of experience. Our undergraduate students have been employed in engineering and industrial work during the summer. (*b*) There is a dearth of civil engineers, largely caused by the number of enlistments in the Officers' Reserve Corps, etc. I anticipate that this condition will continue for some time to come, and that the reconstruction period in Europe will still further increase the demand. (*d*) No particular cases have come to my attention that would lead me to think that the status and pay of engineers have improved greatly in recent times. I still believe that the profession is greatly underpaid and its service unappreciated. The blame rests largely on the members of the profession. When we are willing properly to cooperate and give suitable publicity to our work, then may we expect due recognition from the public.

Young Engineer Earns Less Than Mechanic

W. G. Raymond, dean of applied science, State University of Iowa—(*a*) Hardly a day passes that I do not have to report "no persons available for positions of-

fered." (*b*) Judging from this experience there must be some dearth of engineers. (*c*) A considerable number of engineers have been taken from railway service by the war. A good many young mechanical and electrical engineers have been so taken. More than one-half of our graduating class is in Federal service, all but two of the civil engineers being so engaged. (*d*) There has been an advance in pay, but the young engineer does not yet compare favorably in earning capacity with the mechanic whom he directs.

J. H. DORROH, dean of engineering, University of Mississippi—(*a*) The demand for civil graduates is the heaviest on record. Scarcely any demand in other lines. (*b*) Notable dearth of assistants in civil lines. (*c*) War has robbed civil engineering—notably highway and municipal branches—of most assistants (instrumentmen, draftsmen, etc.) (*d*) I know of improvement in status and pay of engineers, but also know that present conditions do not justify conclusions that engineering is the most lucrative profession now, or probably will be soon—at least not in our territory.

STANDARDIZATION REDUCES DEMAND FOR BRAINS

W. P. GRAHAM, dean of applied science, Syracuse University—(*a*) We have had an unusual demand for men trained in engineering, but no marked demand for men with special training. (*b*) The war has taken a number of our graduates employed in electrical work, but it is difficult to estimate what proportion of engineers have been taken from the electrical field as a whole. The volume of business is unusually great, and men are required to handle it. This would account for the ease with which any man who has a technical education can secure a fairly good position. There has been for some time a tendency of large corporations to consolidate their engineering work, so that one experienced man with the help of a number of comparatively low-paid assistants could handle much more work than formerly. The war seems to increase this tendency. (*d*) Pay of men just out of college has been increased perhaps 25% on the average. Experienced men command better salaries than ever before, but this seems to be true of most professions and trades. It is difficult to foresee the effect of the war on the engineering profession, but there has been a great advance in finding out the best ways of doing things and then in standardizing; standardization always means a reduced demand for skill and brains.

A. W. SMITH, dean of Sibley College, Cornell University—(*a*) There never was a time when mechanical-engineering graduates were in such demand. (*d*) I should hesitate to make an affirmative statement. The war will stimulate many lines of activity besides that of engineering.

ENGINEERING TRAINING VALUABLE FOR BUSINESS

G. F. SWAIN, professor of civil engineering, Massachusetts Institute of Technology and Harvard University—(*a*) There has been a large demand for graduates in civil engineering, and I personally have had many applications for men which I have been unable to fill. (*b*) I think there will be a dearth of civil engineers. I consider it of the greatest importance that young men should be encouraged to pursue engineering studies or, speaking more generally, studies in applied science, in order that there may be an adequate supply of trained men during and immediately after the war. (*d*) I do not know of any improvement in the status or pay of engineers, except what would naturally result from the increasing demand and lessening supply. I see no reason for the conclusion that engineering is soon to be the most lucrative of professions, but I have always believed that the status and pay of engineers should be greater than it is. Improvement must come mainly from within and from the increased value which technically trained men prove themselves to possess. It will not come from talk about the status of the engineer. Natural laws apply here as elsewhere. An engineering training is valuable for fitting a man not only for technical engineering positions, but also for business in which a knowledge of applied science is desirable. I look to see men trained in engineering taking the lead in business in the future to a greater extent than they have in the past.

C. D. MARX, professor of civil engineering, Leland Stanford Junior University—(*a*) There is a large demand for graduates in mechanical, civil, electrical and chemical engineering to take the places of men who have enlisted or have been drafted. (*b*) The Western Union Telegraph Co. is losing more men than it can replace, and so are some of our larger irrigations works. (*c*) At present I have no lines on other fields of engineering where the war has temporarily or permanently taken an appreciable proportion of the engineers engaged. (*d*) I know of no cases of improvement in the status and pay of engineers to support the view. I think the view is absurd and not warranted by any facts.

W. H. SCHUERMAN, dean of engineering, Vanderbilt University—(*a*) We have been receiving more requests for graduates in engineering than we have been able to supply. (*b*) I believe the supply and demand are about equal. (*c*) According to my observations, the war has taken a considerable proportion of the civil engineers. (*d*) I do not believe there is any basis for the view. Should such a view become general, the attendance at engineering colleges would undoubtedly increase as it did from about 1900 to 1910, to be followed by a slump such as has occurred in civil engineering during the last four or five years. I do not believe that dissemination of such a view to be in the best interests of the profession.

IN ENGINEERING SOME MEN CAN SERVE BEST

CHAS. H. SNOW, dean of applied science, New York University—(*a*) The demand for graduates is greater than the supply. (*b*) Apparently there is a dearth of men in the divisions mentioned. (*c*) All branches. (*d*) I do not know of anything to warrant the assumption. I have no doubt that with the increasing need for men more students will enter our colleges, so that an equilibrium will eventually be re-established. Incidentally, I may say this university does not encourage men to enter the profession of engineering with the money idea paramount. We are old-fashioned enough to emphasize the fact that engineering is a means by which some men can serve their time and generations best.

The National Army's Three Southern Cantonments

An Account of Progress

By H. D. HAMMOND
Associate Editor, "Engineering News-Record"

Logging Roads Carry Lumber to Each Brigade at Columbia Camp

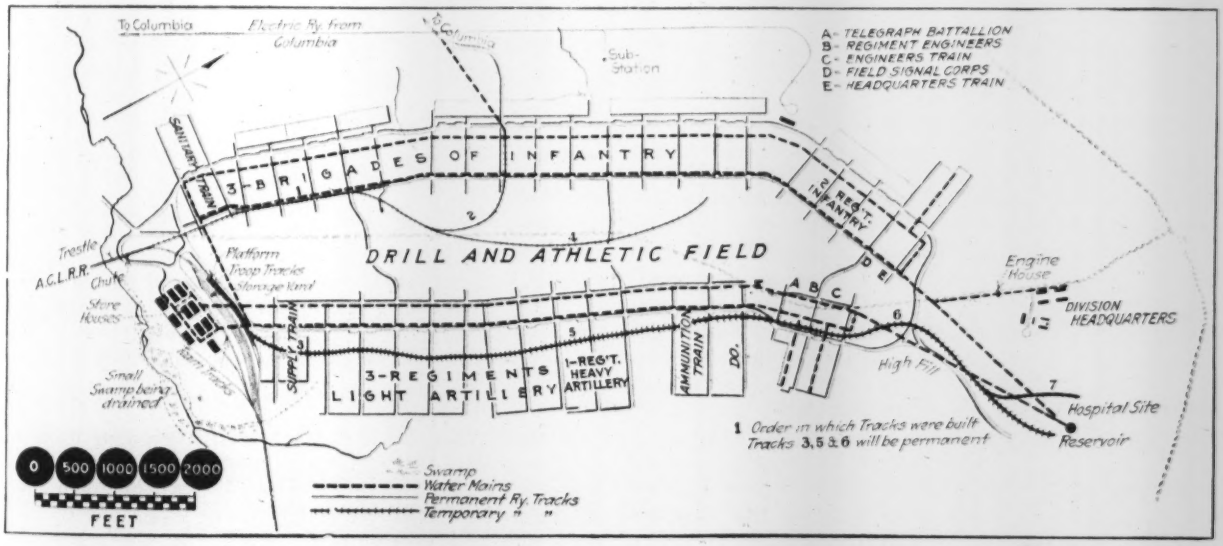
Topography Adapted to Efficient Distribution—Earth Reservoir To Build and Big Swamps To Drain—Railroad Yard Designed for Expansion—Large Auditing Force Expedites Details

LOGGING railroads of standard gage, laid close to the contour lines at a rate of 2000 ft. a day for each gang, are aiding the rapid construction of the new National Army cantonment at Columbia, S. C. The camp, stretching across a series of ridges, is so planned that each brigade on the west side of the site is draped across a "hog-back," on the ridge of which is a spur from the construction road. From these tracks the lumber is handled down hill to the point of use, by team and motor truck. The camp has a permanent receiving yard and storehouse layout which, because both of its design and location, can be expanded at will if the trackage at first provided should be overtaxed. A 1½-million-gallon earth reservoir, concrete lined, is being constructed on a high hill overlooking the camp proper; and large swamps, one of which may be drained by floating dredge operations, add to the difficulties.

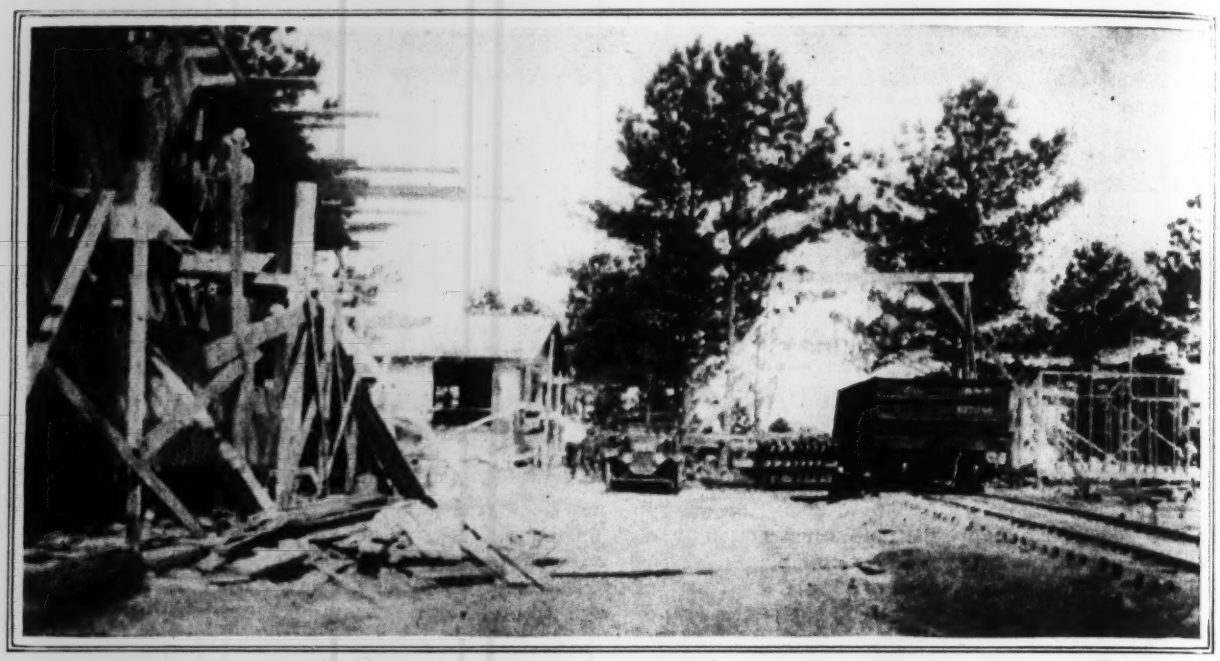
The carpenter work is organized on the same principle as that at Ayer, Mass., different forces following each other with successive operations on the buildings. The sawmills, however, of which 23 are in use, are scattered at the buildings under way, instead of being grouped at unloading points. Local labor is being extensively trained for carpenter work, it taking about six days to make a good rough carpenter out of a raw recruit. As at other camps near good-sized cities, the housing and feeding of the working force is not a serious matter—less than a third living at the site.

The auditing and checking system in use has been worked out in great detail, and 9000 men are paid off in cash weekly, two days after the payroll closes, in less than two hours.

To connect with the Atlantic Coast Line R.R., three miles of fairly heavy construction, ending in a high trestle on the reservation, were necessary. During the short time after the award of the contract, while this work was going forward, the motor-truck company sent to the site was invaluable, delivering a large quantity of lumber and supplies from Columbia to start the work. The high trestle, which is shown in one of the illustrations, will be utilized to eliminate shoveling in handling materials for the 3000 to 4650 yd. of concrete required at the camp. Bins have been built at the north end of the trestle into which hopper cars can dump and from which trucks can be loaded. In order to operate the trucks from these bins to the higher general level of the camp, about 300 ft. of extra roadway was built. This scheme has proven very satisfactory.



LOGGING ROADS THROWN DOWN AT RATE OF TWO THOUSAND FEET A DAY REDUCE AVERAGE HAUL



EVERYTHING IS UNLOADED NEAR POINT OF USE—GALLOWS FRAME AND CHAIN BLOCKS TAKE OFF PIPE

The peculiar site lends itself readily to the rapid extension of temporary railroad tracks. The various brigade sections are arranged in two parallel lines with a parade ground between, the eastern line being well back on a plateau and the western line being on the edge of the plateau toward Columbia. Into this edge, small wet-weather streams have cut a number of notch-like valleys, leaving a series of little ridges. The layout has been arranged so that the axis of each brigade located at this side of the site lies near the crest of a ridge.

Logging Roads Thrown Down Quickly

The receiving yard and main storehouses at the southern end of the east row of buildings mark the point where the railroad connection enters the site. Down the center of this line of buildings the track has been extended practically on the surface of the ground, being laid by logging-road methods by a small crew at the rate of 2000 ft. or more a day. From this point another line turns off across the future parade ground, spurs from it in turn extending out onto each of the "hog-backs," as shown in the plan. This track system, giving rail delivery to the center of each brigade group and gravity delivery from the unloading point to all of the work on the western side of the site, was readily constructed, as it follows closely natural contour lines. No grading and very little clearing were required, the site being mostly open. The soil is sandy and dries rapidly even during periods of heavy rains, such as were experienced at the camp last month. On this account, there is little trouble with soft track. One or two derailments from other causes, such as a car running off the end of one of the spurs, have occurred; but on the whole the tracks proved very satisfactory. One locomotive, rented from the Atlantic Coast Line, has been able to handle the business at the camp, which runs about 50 cars a day, mostly lumber. It is operated 18 hours a day, two crews being employed. Not a cent of demurrage has been collected from this cantonment as yet by the railroad. It is estimated that about 26,000,000 ft. of lumber will be handled by this system, fully half of which had been unloaded before the end of July.

Average Haul Only 500 Feet

With this track system, the average distance which the lumber and other building material had to be hauled by team was reduced to 500 ft. This greatly reduced the trucking, about 200 teams, in addition to the motor-truck company, being required for distributing lumber.

The hospital site and the reservoir are located on a high hill east of the plateau on which the main camp is situated. It was at first thought out of the question to run a logging railroad to the top of this hill, and therefore construction was started early in the work on a heavy fill across the valley up to this hill for one of the permanent camp roads. But the logging-road engineers have by now found their way even to this site. The reservoir, which is circular, was excavated at the top of the hill with slip scrapers. Ten feet deep, it is 130 ft. across the bottom and 150 ft. in diameter at the top. It will contain 1¼ million gallons and will be filled by city pressure through a 16-in. main from Columbia. In addition to it, one 30,000-gal. elevated tank filled by pumping is to be provided for fire service.

Work Carried from South End

Naturally, work was started on the brigades nearest the south end of the reservation. Those on the west side were selected first, and after three of them had been given a good start a beginning was made on the east side and at the warehouses. As the work ad-

vanced, efforts were made to save all of the trees that did not actually interfere with building operations, and the camp will have the benefit of considerable shade as a result.

The same difficulty with securing hardwood posts as occurred at Petersburg was also met at Columbia. To meet it, 8- and 10-in. trees cut on the site were sawn square and used for posts. Dimension lumber was also difficult to obtain, and in many places where the plans call for joists and other members of single sticks, built-up members had to be used in order to save delay. It appeared that there was a plentiful supply of dry boards on hand in the Carolina territory from which this cantonment is provided with lumber, but that dimension stocks were exceedingly low, everything furnished having to be sawed.

The carpenter work is organized in 20-man gangs, each under a foreman. Over every 10 of these gangs is a general foreman. The work is carried on progressively, being divided according to the class of operations and not according to territory covered.

Many Carpenters Broken In

One man is in charge of all of the carpenter work, in addition to which there is a general superintendent for the electrical work, for the plumbing, for the sewer work, for the water lines, and for the common labor employed. A fairly plentiful supply of good labor was obtainable locally, and this labor was encouraged to buy itself a few simple tools and learn rough carpenter work. It is estimated that in about six days, on an average, one of these men can be trained into an efficient saw and hatchet man. They are not, of course, relied on to do the finish work.

About 3000 of these men board at the camp, while a less number sleep there. There is a construction camp for negro labor, and many of the white men are housed

ACCOUNTING FORCE IS HOUSED IN BATTALION OFFICES

APPROACH TRESTLE CONVERTED TO GRAVITY UNLOADING

in the permanent buildings. The total force employed exceeds 9000, the larger part of which rides back and forth to Columbia every day. At first a special train, made up of 20 stock cars, was operated from Columbia night and morning. As many as 4000 men succeeded in finding a footing inside and outside of these cars. After the first of August, however, an interurban trolley line was completed to the west side of the site, which considerably relieved the transportation problem.

Treated Sewage Carried Away by Creek

The sewage from the camp will be collected in settling tanks, chlorinated and discharged at the southwest corner of the site into a creek. With this treatment the creek has a sufficient flow to dispose of the sewage safely.

The creek is fed by two swamps, the larger one lying west of the camp site and the smaller one extending around to the east side. This latter, in any event, is to be drained, and it will probably become advisable to drain the larger one also. On account of the boggy ground and the abundance of water, it was decided, after investigating a number of drainage projects prosecuted by floating-dredge, drag line, etc., to blast a channel with dynamite. The method has proved successful.

Railroad Yard Capable of Expansion

The freightyard and warehouses, located at the southeast corner of the camp, are arranged so that additional facilities can be provided easily while the plant is in use. As there is no railroad yard within reach where cars can be sorted out, one had to be provided at the site. As shown on the drawing, it has a ladder track on each end, and can be expanded either by adding a new yard at its north end or by adding additional tracks on the side next the warehouses. The ground being fairly level in this vicinity would make such expansion easy.

Auditing Force Handles Vast Amount of Detail

The timekeeping, checking and accounting on this work, which represents a vast amount of detail, is being handled very efficiently, as a single indication of which it may be cited that 9000 men are paid off in cash once a week in less than two hours. In the timekeeping system employed, there are an inside and an outside time-

keeper, and a separate window and office for every group of 500 check numbers. The inside timekeeper stays at the window all day, issues and receives the checks, receives the records of the outside timekeeper and makes up his part of the payroll. The outside timekeeper has to cover the work and locate twice a day every man at work bearing a number within his section. This is simplified as much as possible by giving consecutive numbers to the carpenters under one superintendent, to the laborers on each class of work, etc. Nevertheless, some of the outside timekeepers have to cover so much territory that their rounds are made on horseback. In addition to keeping the time and paying the men for the contractor, this auditing force checks all materials received and used, pays all bills for material and does the entire accounting work on the job. All duplication of work is saved in this way, the auditing company using the contractor's forms and system, carrying on the work which would otherwise have to be done by a force in the employ of the contractor. This work, once done, constitutes at the same time the Government's check on the contractor's operations on which payment for the cost of the work is made. The force employed to take care of this work numbers about one hundred and fifty.

The work at Camp Jackson is in charge of Maj. William Couper, Quartermaster Corps, U. S. R., under the cantonment division of the quartermaster general's office. Major Couper is assisted by Capt. Adj. Walter M. Crunden. P. H. Norcross is supervising engineer in charge of the design of sewer, water, highways and drainage. The layout of the cantonment was supervised by R. Schermerhorn, Jr. J. E. Gibbons is engineer in charge of field forces. The Hardaway Contracting Co., Inc., is carrying out all the construction work except the road building, which is let under a separate contract to R. M. Hudson & Co. H. B. Crawford is general superintendent for the Hardaway Co. Charles Neville, of Charles Neville & Co., Savannah, Ga., which maintains the accounting force on the work, devised the office system mentioned, which is also in use by the same firm at several other cantonments.

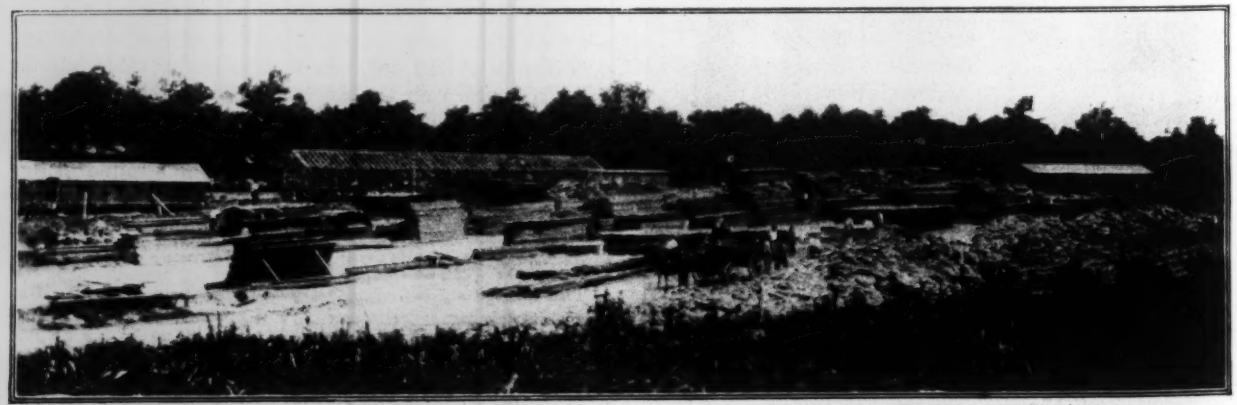
Buildings Stepped To Fit Hillsides at Camp Gordon, Atlanta

Changed Plans Include Outside Stairs and Placing Concrete Lavatory Floors on Wood Sub-Floors—Good Use Made of Light Army Trucks—Road Work Well Advanced

CAMP GORDON, near Atlanta, Ga., varies from the majority of the National Army cantonments in the design of its structures, several changes having been forced by the unusual roughness of the site. To avoid high retaining walls and earth fills, the concrete lavatory floors are being laid on wood sub-floors. Many of the company barracks buildings are being constructed with the main floor at two different levels to conform to hillside locations. The permanent road grading is well advanced, while on the other hand, boulders, rock, and rough topography are making the pipeline construction unusually difficult and have practically precluded the use of trenching machines. The carpenter work is organized in sections, but the power saws working for most of these sections have been grouped at two or three points near the receiving yard. The dirt roads over which the construction materials must be carried are better than the average, and the fullest use is made of the 3½-ton army trucks belonging to the company stationed at the work. Most of the working force of 9000 men is transported back and forth from Atlanta by special trains daily.

Location Almost in Mountains

The site of the camp, about 1000 ft. above sea level and within plain sight of Stone Mountain, is one of the roughest selected for a cantonment. Many of the hillsides on which buildings had to be located dropped 20 ft. or more within the length of a standard company barracks. On this account large numbers of



THOUGH ASSIGNED TO DIFFERENT BUILDING DIVISIONS, THE SAWMILLS ARE ACTUALLY OPERATED IN GROUPS

these buildings have been constructed in two sections, with the floors at different levels, in order to avoid building them on high scaffolding.

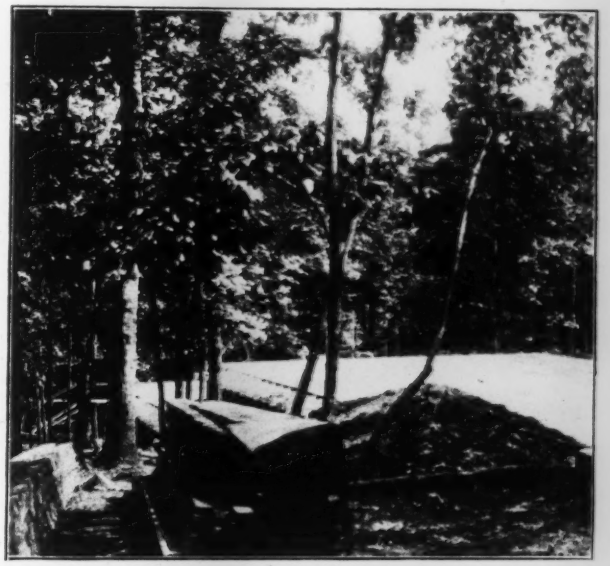
It was found that in places retaining walls 12 and 15 ft. high and a corresponding amount of earth fill would be required to construct the lavatory floors on the ground as shown in the standard plans. To avoid this, all the lavatories are being built with wood sub-floors on posts. The framing for these floors is the same as for the other buildings, a 1-in. floor covered with building paper being laid on top of the joists. On top of this is placed a ⅞-in. wood floor and a 2-in. cement floor. Much more rapid progress is obtainable with this method, and the danger of breaking up the lavatory floors through the settlement of high fills is avoided.

The hillside construction necessitated more stairways than in the standard barracks construction, and to save room inside the buildings all stairways at Camp Gordon are placed on the outside. Although the location is well up in the mountains, it is so far south that winters in which no snow falls are the rule rather than the exception, and on this account the outside stairs are not apt to prove objectionable.

Saws Grouped at Distributing Centers

Of the 24 sawmills on the work, one or two are assigned to each of the 14 building districts, each of which is under a district superintendent employing 10 to 15 foremen. While the mills are assigned to individual districts, they are not operated by the force engaged in constructing the buildings of those districts. A few of them are set up in isolated locations, but most of them are grouped in two main centers, one at the receiving yard and the other near the center of the west group of buildings. Here they are under a sawmill superintendent, who receives lumber from the cars or from the transportation department, cuts it to order for the different sections and turns it over again to the transportation superintendent for dispatch to the point of use.

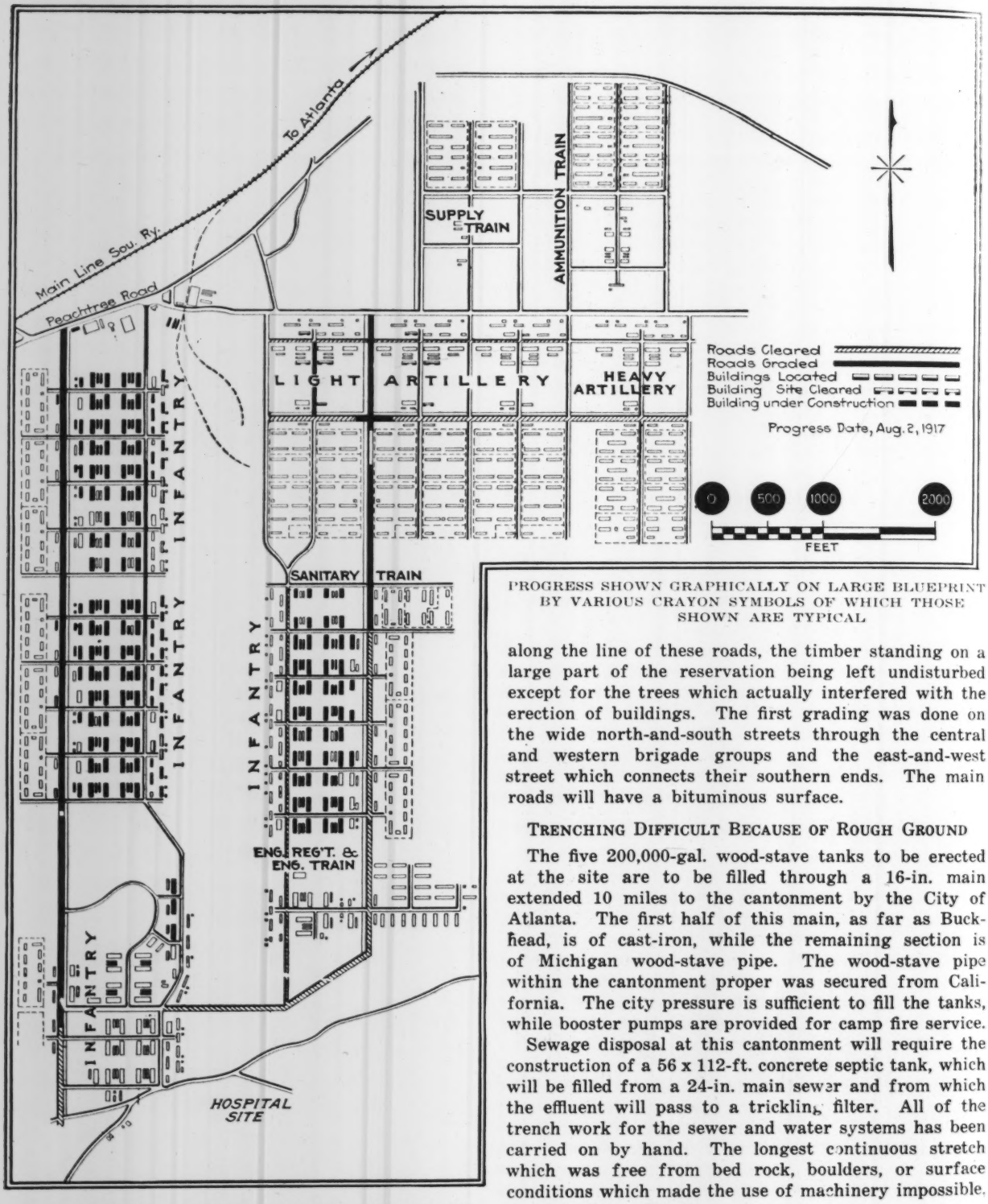
FULL USE WAS MADE OF ARMY TRUCK COMPANY



BUILDING FLOORS AT TWO LEVELS—TREES SAVED

These mills frame between 400,000 and 500,000 ft. of lumber per 10-hour day. The building work at present under way, including 710 main structures, will require about 22,000,000 ft. of lumber, three-fourths of which had been unloaded by the 25th of August. In addition to the 33 3½-ton Velie army trucks and 10 motor trucks belonging to the contractor, no less than 350 teams are required to distribute all this lumber.

MICHIGAN PIPE USED IN 10-MILE PRESSURE LINE



PROGRESS SHOWN GRAPHICALLY ON LARGE BLUEPRINT BY VARIOUS CRAYON SYMBOLS OF WHICH THOSE SHOWN ARE TYPICAL

On Aug. 23 the organization erected a 2-story, 200-man barracks building complete in 9 hours and 20 minutes. About 70 men started on this building in the morning and had it entirely finished by night.

The main streets of the cantonment are being graded by two revolving steam shovels which keep 30 or 40 wagons busy. Most of the clearing work required was along the line of these roads, the timber standing on a large part of the reservation being left undisturbed except for the trees which actually interfered with the erection of buildings. The first grading was done on the wide north-and-south streets through the central and western brigade groups and the east-and-west street which connects their southern ends. The main roads will have a bituminous surface.

Trenching Difficult Because of Rough Ground

The five 200,000-gal. wood-stave tanks to be erected at the site are to be filled through a 16-in. main extended 10 miles to the cantonment by the City of Atlanta. The first half of this main, as far as Buckhead, is of cast-iron, while the remaining section is of Michigan wood-stave pipe. The wood-stave pipe within the cantonment proper was secured from California. The city pressure is sufficient to fill the tanks, while booster pumps are provided for camp fire service.

Sewage disposal at this cantonment will require the construction of a 56 x 112-ft. concrete septic tank, which will be filled from a 24-in. main sewer and from which the effluent will pass to a trickling filter. All of the trench work for the sewer and water systems has been carried on by hand. The longest continuous stretch which was free from bed rock, boulders, or surface conditions which made the use of machinery impossible, was less than 1200 ft.

Many Sign Posts on Work

The letter of each section, which represents a brigade or similar division, and the number of each building, is posted conspicuously on the roads leading to the section and on each building. With this arrangement

no time is lost by the truck drivers, as before a man has proceeded a hundred feet on any road the signs will tell him whether he is headed for his proper destination.

A good indication of the size of the undertaking which one of these cantonments represent is furnished by the contractor's daily reports on operations under way. On July 25, when 429,000 ft. of lumber was placed during the day, it required 11 pages of single-space typewriting to record in the briefest possible language the kind and quantity of work carried out during the day by each division superintendent.

The organization of Major James Norman Pease, constructing quartermaster, differs from that at some of the other cantonments by having each division of the work supervised by a captain under the direction of Captain-Adjutant Coffin in charge of the field office. One captain each is in charge of all of the civilian forces concerned in any way with the following main divisions of the work: Auditing; building location and erection; transportation; electrical installation; water and sewer systems; roads; and sanitation. The constructing quartermaster also maintains an office in Atlanta which is in charge of Captain Israel, Quartermaster Corps. Arthur Tufts is contractor for the work. Under him the organization at the cantonment is headed by E. A. Stuhrman, under whom are two general superintendents, one for all the building construction and one for the remaining work; the purchase and delivery of materials and the office work required in the administration of the contract and the commissary are handled respectively by R. M. Walker and Charles Loridans, partners in the constructing firm, from its Atlanta office. The engineering work is in charge of Lockwood, Green & Co., whose force at the cantonment includes about 80 men. All accounting is in the hands of the auditing firm of Walter Mucklow.

STEAM SHOVELS GRADED MAIN ROADS EARLY

500 Teams Save Day in Deep Mud at Camp Lee

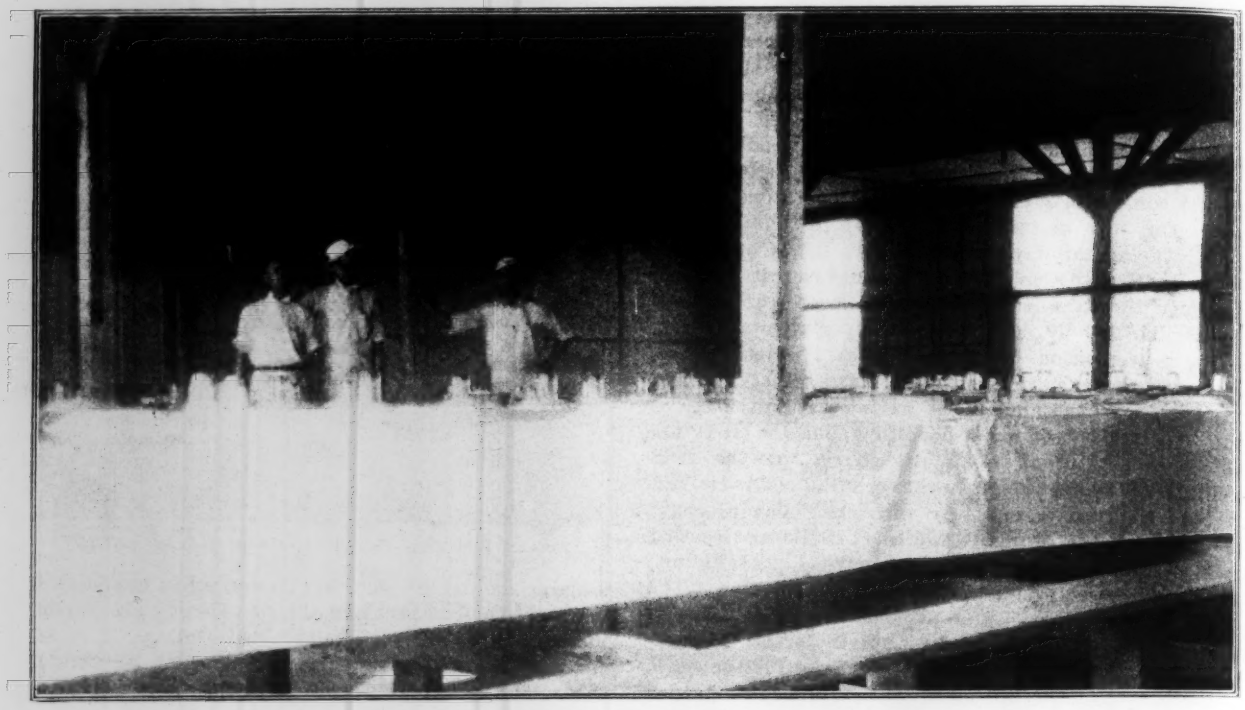
Petersburg Cantonment, with Horse Depot, One of Largest, Organized in Units—Contractor's Engineering Force Used

HEAVY RAINS and deep mud during July reduced the cantonment at Petersburg, Va., to entire dependence on horse transportation, 500 teams and more being required to distribute the 80 carloads of lumber received daily. This camp, one of the largest because of the inclusion of a horse depot to care for more than 20,000 head of stock in addition to the regular animal complement and the 45,000 to 50,000 troops to be stationed there, requires 30,000,000 ft. of lumber, more than half of which had been received before Aug. 1 last. The camp layout in the shape of an L made possible a railroad layout involving less road transportation than at Ayer or Atlanta, but requiring considerably more than the cantonment at Columbia. Of the 5000 men employed, fewer than one-third live at the camp.

The building construction is organized into fourteen separate jobs, or divisions, each of which finishes all work connected with one group of buildings at a time, and into transportation, sewer, highway and water divisions. Each building division has its own saw or saws, set up where it is working and moved with it. Contrary to practice at the other camps, the contractor's chief engineer and regular engineering force have been taken over by the Constructing Quartermaster, and are responsible to him for the design and field work.

The site of the cantonment, while high, is fairly level, most of it being almost flat. On this account the heavy rains experienced during July quickly turned the roads into long successions of mud holes. The camp is in the shape of a hook, through the long shank of which winds a county road which was relocated later. This road fared no better than the temporary roads, in spite of the liberal use of corduroy, brush, cinders and gravel. Because it was a public road it has to be kept open, and because it passed through the camp it soon became a mecca for jitneys bearing sightseers from the surrounding country. At one time the contractor was obliged to keep six teams at work for several days extracting mired automobiles from various sections of this county road. The regular army truck company assigned to the camp was equipped with five-ton machines designed for transport service on good roads, and could not be used extensively while wet weather lasted.

After putting in the necessary railroad facilities and organizing the building work, the first step was to relocate this county road to the west of the camp, and to macadamize all the roads as fast as possible with gravel. The gravel is dug by a steam shovel at a pit opened a mile west of the camp. The pit is located on the line of a new highway being constructed from



"NORTHERN" CONSTRUCTION WELL SHOWN BY THIS INTERIOR OF STANDARD COMPANY MESS HALL

the cantonment to Petersburg. The sand and gravel obtained here have also been screened and used for concrete.

Railroad Half Encircles Camp

The Norfolk & Western R.R., which passes a short distance from the site, constructed with its own forces sidings extending more than halfway around the outside of the camp. From the permanent warehouses at one end of this yard to the new road to Petersburg at the other end, material is unloaded as near as possible to the work for which it is to be used. The number of teams employed is so great that there is a steady stream of material flowing from the railroad tracks down the main roads to the group of buildings under way. An idea of the density of this traffic is gained when one realizes that an average of 80 carloads of lumber a day, besides immense quantities of beaver board and other materials, are unloaded for the building construction alone.

Permanent Warehouses Designed at Job

Before the middle of July it became apparent that the Quartermaster Corps would have to begin in the near future collecting supplies at the depot required in connection with the camp. Orders were therefore received to rush work on the permanent warehouses before the standard plans for these buildings had been issued. The Constructing Quartermaster gave the engineering force the floor loads to be provided for on the afternoon of the day these orders were received. Next morning work was started on the first building, and by the end of the month half of them were ready for use. As at the Columbia cantonment, there was difficulty in securing suitable foundation posts. It had been expected that cedar posts would be employed but the only supply available proved entirely inadequate. To prevent delay, pine posts obtained in clearing parts of the site were used, as there was no local hard wood available in sufficient quantities. These posts are likely to last beyond the training of the troops which it is now intended to raise, and can furthermore be replaced later if necessary.

Work Split Into Sections

The building work is split up into fourteen sections, one section approximating in size the buildings required for a single brigade. Each of these sections is numbered and the section numbers posted on a sign board at roads leading into it. Each is provided with its own sawmills, labor force, rough carpenter force and force of finishers which follow each other in rotation on the buildings within the limits of the section. Each section has its own superintendent and organization, and operates independently of all the others except that it draws its material from the general transportation system for the whole work. From six to eight concrete mixers are kept busy placing lavatory foundations, the mixers being passed from one section to another as required. In addition to these sections there are under the general superintendent of the entire work, a superintendent of teams and transportation, superintendent of roads, and two superintendents on the pipe line work, of which more than 30 miles are required on the job.

White Men Housed in Permanent Buildings

Five thousand or more men were at work at the camp by the end of August, although but 2000 of them slept and ate at the site. The negroes among this

number are cared for in a construction camp, while most of the white carpenters and mechanics who live at the site are housed in the permanent buildings already constructed. The site for the camp is near the electric line from Petersburg to Hopewell, where the Du Pont interests have established a city of 35,000 workmen engaged in the manufacture of explosives. It was feared that the construction of the cantonment might interfere with the operation of this plant, but such has not been found to be the case. This trolley line, two 15-car trains on the Norfolk & Western R.R., and at times the entire fleet of trucks belonging to the truck company transported at least 3000 of the working force to Petersburg and back each day. Indeed, although a 10-hour day is worked, many of the men live in Richmond and use the trolley line between that city and Petersburg twice a day to reach their work. There has not been any particular difficulty in securing and holding labor, and a high grade of skilled labor for carpenter, electrical, plumbing and other work of similar nature has been available.

Increase Petersburg Water Supply

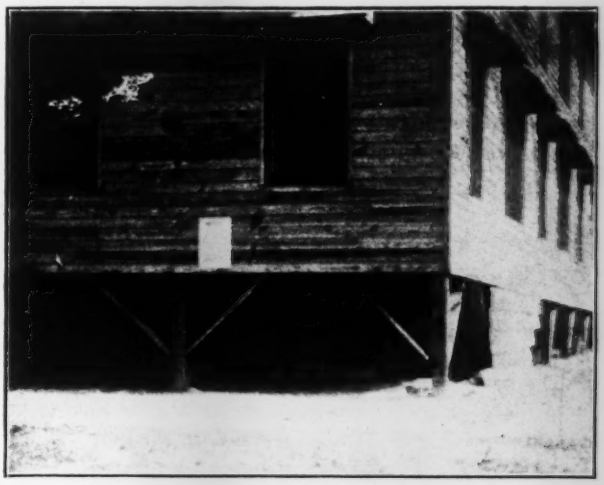
Coagulated river water, 4,000,000 gal. of which are used daily at Petersburg, will be supplied to the camp. For this purpose it has been necessary to increase the capacity of the Petersburg water plant to 10,000,000 gal. a day. This work is now nearing completion. Included in this work, about 10 miles of new water mains were required to bring this water to the camp. Pipe lines 6 in. to 2 in. in diameter supplied the cantonment during the construction. These lines were laid directly on the surface of the ground, but two trenching machines were used throughout the work of laying the permanent water and sewer lines under ground.

Some distance east of the camp proper at the edge of the reservation is a swamp of considerable extent into which it is planned to discharge the sewage. Should it be found necessary to treat this sewage, this will probably be accomplished by means of dosing tanks.

Keep Ground Clean to Guard Against Fire

A man who was formerly chief of the fire department of Savannah, Ga., assisted by six or eight ex-city firemen, is charged with the duty of seeing that the wooden buildings do not catch fire before the camp is finished. These men do not constitute a fire-fighting force, but cover the work as inspectors, seeing that there is not a scrap of inflammable material left on the ground. Shavings, chips, scraps and sawdust are cleaned up and burned daily, and the ground in the vicinity of all buildings swept clean of anything that might propagate a blaze. With these precautions and with the close watch kept, it is not thought necessary to forbid all smoking on the reservation.

In this connection it is of interest to note that the health officer at the cantonment placed an embargo on watermelons, it being a serious offense to bring one near the camp. How this order was enforced, even with the aid of uniformed soldiers, on several thousand negroes during the height of the season in a watermelon country is a mystery; but at any rate watermelon rinds were as conspicuous by their absence as the swarms of flies with which they are usually associated. The health of the force of the camp has been excellent. The teams in use there are not stabled at the site, but are cared for at Petersburg and near-by farms.



GROUND UNDER BUILDINGS SWEPT CLEAN

The work at Camp Lee was in charge of Major Frank B. Edwards, reporting to the cantonment division of the Quartermaster General's office in Washington. Captain Houks is Captain-Adjutant. The construction work, including the road building, is being carried on by the firm of Rinehart & Dennis under the personal direction of Mr. Rinehart. The engineering force of this firm, under the direction of A. J. Seville, its chief engineer, is carrying on all the engineering work, being directly responsible to the constructing quartermaster.

Gravel Car Shortage Seriously Hinders Louisiana Road Work

The Louisiana State Railroad Commission has recently passed an order requiring all the railroads of the state to purchase gravel cars. A. D. Alderson, Vice-President and General Manager of the Tioga Gravel Co., of Alexandria, La., states that none of the railroads in the state up to this time has owned any gravel cars except the Iron Mt. R.R.; consequently when foreign cars were taken out of the state they have had no cars with which to make shipments. Notwithstanding this condition, the State Highway Engineer, Duncan Buie, has done his best to keep road work going.

The Tioga Gravel Co. during July shipped about 1000 cars on orders for 2500 cars, which just about met the running expenses of the plant. Mr. Alderson states that in view of the claims made by the railroad companies, he has noted with surprise that some of the railroads in Ohio have been selling their coal cars to the Canadian Government. He believes that the building of good roads should be coupled in importance with the production of food, and the movement of road material should, under Government order, be given preferential treatment next to food products, iron ore and coal; in other words, the railroads should be given to understand that during the war more than at any other time the building of good roads should continue.

Ice Forms but Sprinkling Filters Go On

With Ice Sometimes Four Feet Thick on Sewage Filters at Rochester, N. Y., Good Winter Work Was Done

By Myron A. Bantrell
Engineer and Chemist in Charge, Brighton Sewage Works, Rochester, N. Y.

ZERO weather, ice and snow were successfully met by the sprinkling filters of the Brighton sewage-works at Rochester, N. Y., during their first winter. The story is told by the accompanying views.

The sewage at these works is distributed on two ½-acre filter beds by Columbus spray nozzles having $\frac{9}{16}$-in. round orifices. The nozzles are spaced 14½ ft. c. to c. and are staggered in rows across the filters. The filter material consists of 6 ft. of 1.2-in crushed limestone. The filters are located in a deep hollow, surrounded by hills and woods on all sides, and are well protected from the winds. There was no ponding of sewage and very little organic growth on the filter beds when cold winter weather set in, the beds having been in operation since March, 1916.

Operating Conditions

During the period of cold weather, Dec. 15, 1916, to Feb. 15, 1917, the following conditions obtained:

The nine lower rows, having 58 spray nozzles, were in use on each of the filters, which were dosed alternately by Miller siphons. The nozzles operated under a head varying from 7.5 ft. maximum to zero, and each nozzle discharged 68 gal. in 6½ min., with a rest period of 10 min. An average of 700,000 gal. of sewage per day reached the plant during this period. The total filter area in use was 0.54 acre, making the rate of filtration 1,300,000 gal. per acre per day.

Snow and 30° F. Brought First Ice Cover

Ice formed on the filters for the first time after a 12-in snowfall on Dec. 22, 1916, with an air temperature of 30° F. The ice was on the underdosed area in the zone 6 to 7 ft. from the nozzle and on areas in line with the overhanging arms of the nozzle. There was not enough sewage sprayed on these areas to dissolve the snow, but enough to congeal it, forming ice to a maximum thickness of 12 in. Fig. 1 shows how the ice appeared on Dec. 27.

On Jan. 11, 1917, after a snowfall of about 6 in., the temperature fell to 3° F., with the result shown in Fig. 2. The thick cakes of ice in evidence show the spots where the first ice formation was not completely melted away by the early January thaw. It continued cold on Jan. 12, and the beds were 70% covered with ice of 12 in. maximum thickness.

The temperature dropped to —4° F. on Feb. 3. This was preceded by several days of freezing weather and snowfalls. The beds were 95% covered with ice, as shown by Fig. 3. A thin layer of ice formed by the freezing sewage is seen to cover the overdosed areas around the nozzles. This ice was well perforated and did not obstruct the percolation of the sewage, as no ponding of sewage on the surface resulted. The thin layer of ice melted away by noon.

Fig. 4 shows ice formation on Feb. 10, with a temperature of —4° F. The ice was 42 in. thick in places.

With four days of below-zero weather preceding, the temerature dropped to —8° F. on Feb. 13. Fig. 5 presents the appearance of the ice around the nozzles early in the morning.

By the middle of the afternoon the ice on the overdosed areas adjacent to the nozzle appeared as shown in Fig. 6. The effect of the arms on the nozzle is clearly demonstrated in this picture. There was some ponding of sewage on the beds, immediately after the display period, but this sewage leached away within a few minutes.

It began to thaw on Feb. 17, and by Feb. 23 the ice on the lower portion of the west bed appeared as shown by Fig. 7. In the foreground of the view the shape of the area covered by the Columbus nozzle is clearly outlined.

On Feb. 20, with 25 in. of snow on the upper portion of the beds, the spray nozzles were put into operation. Within four hours the snow was melted on the overdosed areas adjacent to the nozzle. Fig. 8 shows the east filter bed after the heavy snowfall of March 6.

After the mid-March thaw the ice melted rapidly. Fig. 9 shows the skeletons of the ice formations around the lower nine rows on March 18. The upper portion of the bed, which was put into operation on Feb. 20, is seen to be practically clear of ice. Fig. 10 shows the remains of ice on the west filter bed on March 22. Four days later the ice was completely melted away.

The accompanying table gives the average results of analysis for the month of January, and from Feb. 1 to 15, 1917.

WINTER ANALYSES OF APPLIED AND FILTERED SEWAGE

	Applied Sewage		Filter Effluent	
	Jan.	Feb.	Jan.	Feb.
Temperature, degrees F., average	46.4	44.4	40.2	36.3
Temperature, degrees F., maximum	48.0	46.0	44.0	41.0
Temperature, degrees F., minimum	45.0	43.0	37.0	34.0
Relative Stability Methylene Blue 37° C.:	Unstable	Unstable	Stable	Stable
Dissolved oxygen, p.p.m.	2.9	3.2	7.8	7.7
Nitrates, p.p.m.	0.0	0.2	2.3	2.5
Suspended solids, p.p.m.	35.0	46.0	3.5	5.6
Chlorine, p.p.m.	50.0	50.0	50.0	50.0

Demonstrating Water Loss by Leaks

A device for demonstrating to water consumers how their bills are increased by the loss of water in the smallest plumbing leaks (with water running continually) has been installed by Ellis R. Goldman, superintendent of the Water Department at Rockford, Illinois.

A glass-incased meter is secured to the counter in the public office, and its discharge pipe is led upward so as to project over a galvanized-iron tank 12 x 12 in. and 14 in. deep. On the end of this pipe is a multiple cock, consisting of a revolving disk or turret having radial branch pipes ending in nozzles with openings of $\frac{1}{64}$ in. to $\frac{3}{8}$ in. The branch which projects vertically downward over the tank is the only one open to the pipe when the water is turned on.

When a cubic foot of water is allowed to run through the meter, as indicated on the dial, the consumer can see some relation between the dial reading and the quantity of water in the tank. By means of the multiple cock, he is also shown that the meter will register the flow through an opening as small as $\frac{1}{64}$ in., thus warning him against leaky plumbing.

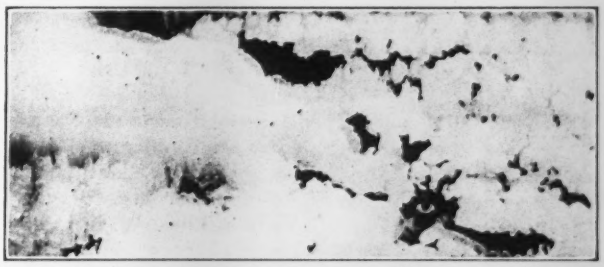
1. FIRST SNOW AND ICE ON FILTERS AS SEEN DECEMBER 27, 1916

2. JANUARY 11, 1917, THE TEMPERATURE FELL TO 3° FAHRENHEIT

3. THE TEMPERATURE DROPPED TO —4° FAHRENHEIT ON FEBRUARY 4

4. FEBRUARY 10, MERCURY AT —4° FAHRENHEIT, ICE WAS 42 INCHES THICK

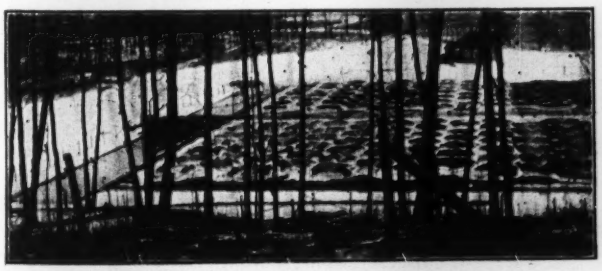
5. ICE AROUND NOZZLES EARLY FEBRUARY 13, WITH TEMPERATURE —8° FAHRENHEIT, AFTER FOUR DAYS BELOW ZERO



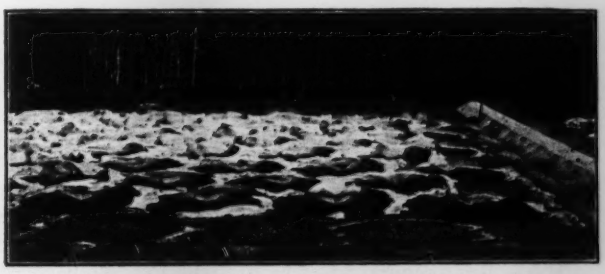
6. BY MID-AFTERNOON, FEBRUARY 13, ICE ON THE OVERDOSED AREAS ADJACENT TO NOZZLES WAS MUCH REDUCED

7. A THAW FROM FEBRUARY 17 TO 23 LOWERED THE ICE ON THE LOWER PART OF THE WEST BED

8. AFTER THE HEAVY SNOWSTORM OF MARCH 6 THE EAST BED WAS NEARLY COVERED WITH SNOW



9. THE MID-MARCH THAW MELTED THE ICE RAPIDLY AND PRACTICALLY CLEARED THE UPPER PART OF THE BED



10. ON MARCH 22 LITTLE ICE REMAINED ON THE WEST FILTER AND FOUR DAYS LATER IT WAS ALL GONE

Sand and Gravel Digger Designed and Built for Ohio River

Machine To Raise Concrete Aggregate from Stream Bed for Use on Locks and Dams Constructed by Army Engineer—Equipment Produces 800 Cubic Yards in Eight-Hour Day

By A. W. KREAMER
Junior Engineer, United States Engineer Office, Wheeling, W. Va.

THIS MACHINE DIGS 800 CU.YD. OF SAND AND GRAVEL PER DAY FROM THE OHIO RIVER BOTTOM

IN CERTAIN parts of the Ohio River concrete aggregate is supplied from the sand and gravel river deposits by digging from a floating plant known locally as a "sand and gravel digger," or just "digger." For two locks and dams near Wheeling, W. Va., now under construction by the United States Army Engineers, such a machine was required. The writer had the task of designing this plant and succeeded in adding a number of improvements not found on existing plants in the district. The first trouble encountered was the absolute lack of literature covering any floating plant that could be applied here. It will therefore be the object of this article to put on record some of the difficulties overcome, and the arrangement decided upon, as well as the cost and the performance of the plant in general.

Machine of the "Boot-Jack" Type

From a study of the existing plants in the vicinity of Wheeling it was decided to make the new sand and gravel digger of the bucket type and on the "boot-jack" style, with a ladder made from 60-ft. timber, trussed and braced as shown in the drawings. This ladder is hinged on the driveshaft at the top and is supported at the bottom by a yoke connected through wire rope and sheaves with a hoisting engine, thus allowing the ladder to be lowered or raised at the will of the operator. The height of the driveshaft above deck is such that it provides ample slope for the sand and gravel chutes, and also allows a maximum depth of 20 ft. below water surface for digging. This depth was considered sufficient, as very few deposits are deeper than that in this vicinity.

It has been general practice to make the top, or drive drum, on the ladder square, and the bottom, or idler drum, hexagonal. The writer believed and has proved that a five-sided drum would work just as well, and with less wear. The claim was made by some of the manufacturers in the vicinity that a six- or a five-sided drum at the top of the ladder would cause trouble by allowing the chain to slip, and thus eventually either break the chain or the drum. Regardless of this claim the top drum was made pentagonal and the bottom drum was made hexagonal, both of ribbed and flanged cast-steel wheels with structural-steel connecting bars. The plant has been in continuous operation for two seasons now, and no trouble has been experienced with slipping. Furthermore, there is no reason to anticipate any trouble along that line, and a comparison with other plants shows the drum to be in better condition than its four-sided brethren.

In order to keep the drums from becoming too large and heavy, the chains, which are of the pin-connected type common to sand diggers, dredges, etc., were made up of links 21 in. c. to c. of pins. These links are made from the best grade of structural steel and the pins from the best grade of tool steel. The small idler rollers upon which the chains travel are made from manganese steel. The resulting wear on the different parts has proved satisfactory.

Buckets Spaced Far Apart

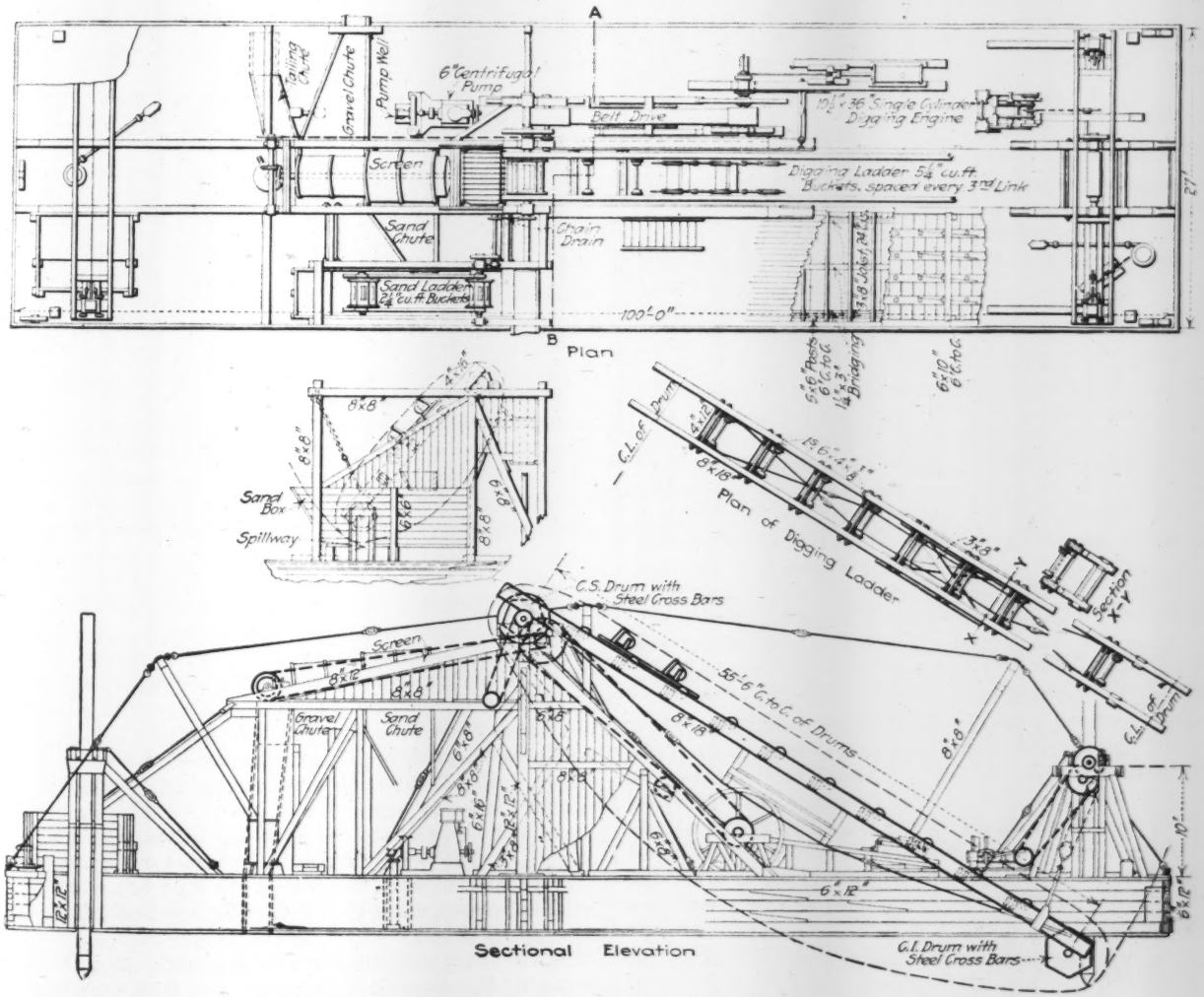
Buckets when placed too close together on the chain, will come up only partly full. To assure each bucket getting its full capacity the buckets were spaced every third link on the chain. In order to keep the speed of the chain low and still get the required capacity, the buckets were made with a capacity of 5½ cu.ft., when the material is considered "heaped" 3 in. at the center of the bucket.

Buckets are made of the best grade of structural-steel plates and reinforced by strap plates and angles. The lip of the bucket is reinforced with a "cutting edge." The body of the bucket is punched with $\frac{5}{16}$-in. holes spaced about 6 in. apart to allow escape of water.

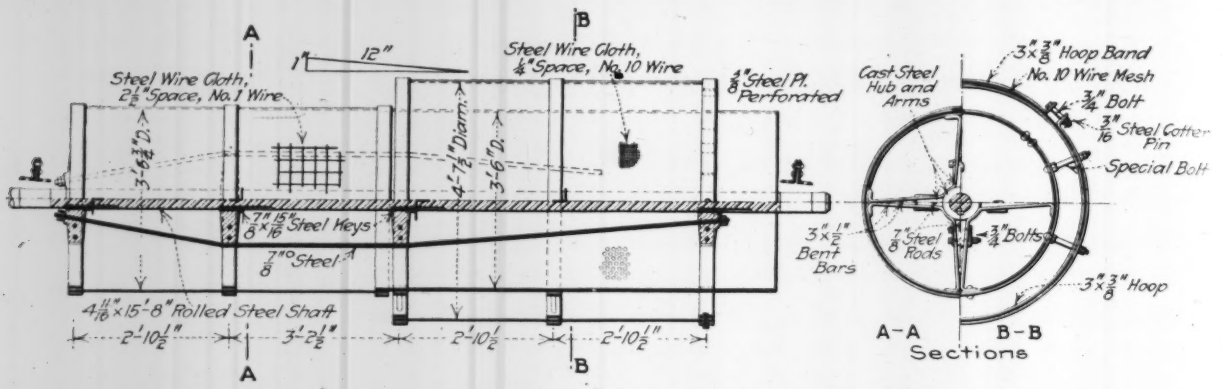
Experience on the river has shown that the speed of the digging-bucket chain should be such that 7½ to 9 buckets will be dumped every minute. The plant was desired to have a minimum capacity of 600 cu.ft. of material per 8-hour day. From this and the other governing conditions it was found that the top drum would have to have a speed of five revolutions per minute.

The buckets on the main ladder dump their contents upon sloping gratebars made of 4 x ¾-in. steel, set on edge and placed 5 in. apart, thus excluding all material that is larger than 5 in. in circumference. The slope is sufficient to cause nearly all large rocks to roll off the bars and fall back into the ladder well. Occasionally it is found that rocks become wedged between the gratebars and it is necessary to pry them out. To help this rolling off of the large material and also to supply water for washing the sand, a 2-in. stream of water, supplied by a centrifugal pump, plays upon the grate-bars at about their center, which has been found effective.

Under the grate-bars is a sloping steel pan that discharges the material into a revolving screen that is also set on a slope. This screen is of the center-driveshaft type, with built-up "spiders," has a speed of about 18 r.p.m., and is made in three separate parts. The first part consists of a boiler plate perforated with $\frac{13}{16}$-in. diameter holes, spaced 1¼-in. centers on 60° lines, thus allowing all material up to that size to pass into the outer space. Around this outer space is the second part consisting of a sand screen made of No. 10 B. W. G. meshed wires with ½-in. openings between them. All sand and gravel up to ½ in. in circumference will therefore pass out through this screen and fall into a sloping chute that discharges into the "wash-box." The material over $\frac{13}{16}$ in. in diameter travels along the boiler plate into the third part of the screen, consisting of a gravel screen made of No. 1 B. W. G. meshed wires with 2½-in. openings between them. Material up to this circumference therefore will pass out through this screen and fall into a sloping chute that discharges directly upon a gravel flat lying alongside the digger. The gravel between the ½ and the $\frac{13}{16}$ in. sizes is also discharged into the above chute at the end of the sand screen, and thence out onto the flat. All material over



DETAILS OF DESIGN OF OHIO RIVER SAND AND GRAVEL DIGGER



SPECIALLY DESIGNED REVOLVING SCREENS USED ON SAND DIGGER

2½ in. in diameter is considered undesirable for this class of work and is therefore allowed to travel on to the end of the screen, where it discharges into a "tailing chute," that empties near one side and underneath the boat. When the digger is working on a bed that is near the surface of the water, this deposit from the tailing chute sometimes piles up close underneath the boat. This has not proved a serious defect, however, as it is merely necessary to watch the deposit and shift the digger slightly before the pile becomes too high.

Wash-Box Cleans Sand Effectively

As stated above, all gravel up to ¾ in. in circumference, with sand and water, is discharged by a sloping chute into a wash-box. From this wash-box the material is again elevated by a ladder containing eighteen 2½-cu.ft. buckets. These buckets, ladder and drums are made of the same class of material and similar to the main ladder equipment. The driveshaft at the top of the ladder has a speed of 3 r.p.m., which allows 7½ buckets per minute to discharge their contents into a sloping chute that empties onto a sand flat lying on the opposite side of the boat to that on which lies the gravel flat. This ladder is also hinged on the top driveshaft and is supported by a 3-ton differential chain hoist and a yoke at the bottom, which allows the cleaning of the wash-box whenever desired. This wash-box puts the sand in a good, clean condition and at the same time gets rid of all small foreign substances, including mud, twigs and small flakes of coal, which in some beds are very plentiful in this section of the river. All surplus water and these foreign substances are allowed to overflow in a spillway discharging back into the river at the side of the boat.

The sand, gravel and tailing chutes are all made of wood and lined with No. 13 U. S. standard gage sheet steel. The parts that extend out beyond the edge of the digger are hinged and so arranged that they may be hoisted into a nearly vertical position when they are not in use; thus putting them where little damage could be done when other boats are near. Both sand and gravel chutes discharge onto crown-deck flats, so that all water may run off, thus leaving comparatively dry sand and gravel.

The revolving screen is a special design made by the writer and has proved very satisfactory. The claims for the design over some of the more standard product are simplicity of repair, ease of removing and replacing screens, rigidity, and speed in handling the material from the main digging ladder. It is a well-known fact that the spiders of all revolving screens of this type will wear very rapidly regardless of the material from which they are made. For this reason, the part nearest the screen, or that which would receive the most wear, was made of standard flats, requiring only bending and drilling before being placed in the screen. The separators between the perforated plate and the sand screen are also subject to severe wearing, and therefore they were made of standard product that could be repaired easily by any small shop. The heavy cold-rolled steel shaft, trussed as it is with the ⅞-in. rods at the cast-steel spider arms, is a very rigid construction and one that has very little deflection regardless of the great amount of material that is always revolving in the screen. The design has an additional advantage that has proved to be worth considerable from the up-keep standpoint—namely, either screen can be made in 3-ft. widths, and the method of holding the screen in place also allows shorter lengths than the entire circumference to be used if so desired.

Experience has shown that the upper end of each screen wears out the more rapidly. This would mean a complete screen destroyed were it made of one piece for the entire length. In this design two screens were used for both sand and gravel, thus allowing each to have their full life. At the end of two seasons' run, only one 3-ft. section of sand screen and two 3-ft. sections of gravel screen were purchased, not including the original screens put on the boat when built.

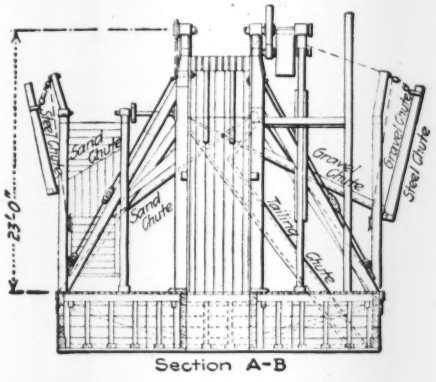
Water for washing the sand is supplied in two ways: First, on the grate-bars as described in an earlier part of this article, and second, from one manifold pipe extending along each side of the sand screen. Each manifold pipe has twelve ¾-in. outlet pipes or nozzles that throw streams direct onto the revolving screen. This method helps to separate the sand from foreign material and also to keep the openings in the screen from clogging. All water is caught by the sand chute and sent on into the wash box, where the sand being handled a second time has another chance to free itself from all foreign substances.

The following machinery was provided: One 100-hp. boiler of the return-tubular type; one 6-in. centrifugal

pump direct-connected to a vertical 2-cylinder steam engine, size 6 x 5 in.; one single-cylinder horizontal long-stroke steam engine, size 10½ x 36 in.; one 2-cylinder horizontal reversible hoisting engine, size 6¼ x 8 in.; one direct-acting duplex boiler-feed pump, size 4 x 2⅝ x 5 in.; one 100-hp. feed-water heater and two steam capstans with worm-gear drive.

As an assistance in maneuvering and holding the boat, it is provided with four white oak spuds 14 x 14 in. by 32 ft. They are operated by lines from the two steam capstans, are equipped with pointed cast-iron shoes and bear on cast-iron rollers located both in the hull and in the overhead frame.

The hull has 3-in. bottom planking, 3-in. deck planking, 6-in. gunwales, two 6-in. longitudinal bulkheads which for part of the way form the ladder well, one 6-in. transverse bulkhead at the end of the ladder well, 6 x 6-in. side posts, 6 x 10-in. braces, 3 x 8-in. bottom stringers, 3 x 4-in. stanchions and 3 x 8-in. deck joists with 1¼ x 3-in. bridging. The outside corners are protected by ⅜-in. steel plates, and the end of the ladder well is



OUT-BOARD CHUTES ARE HINGED

reinforced by two U-shaped and four L-shaped ⅜-in. steel plates.

In the original design a chain and a chain drum were used to hoist the digging ladder, but under actual working conditions it was found that there was insufficient friction for the engine to hold the ladder when it (the engine) was in the neutral position. To overcome this the drum was wrapped with rope and a 5-part wire line with two steel sheaves were used instead of the chain.

Under average working conditions the boat will dig 800 cu.yd. of material in an 8-hour day, and has been known to make 1200 cu.yd. when in a well-proportioned bed near the surface. With boat at full capacity only three men and a foreman are required. A watchman stays on board at all times other than during working hours. The original cost estimate of the boat complete was $14,000, and the actual cost was not far from that figure.

The boat was designed by the writer under the general direction of Maj. T. H. Jackson, Corps of Engineers, U. S. A., and Guy B. Bebout, Assistant Engineer, Wheeling, W. Va. The hull was built at Dam No. 28 under the direction of W. A. Wells, Junior Engineer, and all above deck was built at Dam No. 21 under the direction of George C. Ross, Assistant Engineer.

Coaling Plant Delivers Coal to Self-Unloading Barge

Electrically Operated Layout Has Crusher, Conveyors and Locomotive Cranes—Barge Distributes Coal Along River

TRANSFER of coal from cars to a bunker for loading a hopper barge equipped with discharging conveyors is the essential feature of new coal-handling facilities for the Milwaukee Electric Railway and Light Co., at Milwaukee. These have been made necessary by a change from water delivery to rail delivery of coal, due to changing the company's source of supply.

Coal has to be delivered at the river front, as it is distributed to the power plants by the barge. The new yard is 680 x 280 ft., on the Kinnickinnic River. It has a crusher and conveying plant, with stockpile and 1500-ton bunker. The equipment at the old yard was utilized, and all machinery is electrically operated. The plant was designed and constructed under the direction of John Anderson, chief engineer of power plants, the work being done by company forces. The cost, exclusive of land, was about $75,000.

Coal Is Handled by Conveyors and Locomotive Cranes

Coal may be unloaded at the stockpile by electric locomotive cranes with 1½-yd. grab buckets, or it may be taken directly to the crusher and delivered to the bunker for loading the barge. The company's contract calls for separation of screenings and lump at the mine, so that ordinarily the former are used at once and only the lump coal is stored. This reduces the liability of spontaneous combustion in the stockpile. The cars are handled by a steam locomotive, as trolley wires would interfere with the operation of the cranes.

Coal in dump cars is unloaded at a track hopper 40 x 20 ft. At the bottom of this are two shakers, through which the coal passes, falling upon a 36-in. belt conveyor 67 ft. long. This is driven by a 15-hp. motor at a speed of 240 ft. per min. It rises at an angle of 19½° and discharges into the feed hopper of the crusher. Cars which cannot be dumped are placed near this hopper and unloaded by the cranes. The hopper has three sides sloping at 45° to give a rapid feed of the coal delivered by the conveyor. The other side is sloped only 30° to give a slower feed of the coal delivered by the crane buckets. This arrangement prevents overloading of the crusher.

The crusher is of the single-roll type, which has been found to give satisfactory service with low maintenance charges, even when handling the harder grades of coal. The roll is 36 x 36 in., belted to a 100-hp. motor. This crusher, reducing coal to 1½-in. size, can handle 250 tons per hour.

The coal from the crusher falls upon a 30-in. belt conveyor 150 ft. long, rising at 22½° to the loading bunker. The belt delivers the coal to a 30-in. flight conveyor extending the full length of the bunker. By utilizing the return side of this latter conveyor to trim the top of the coal, the capacity of the bunker has been increased by about 150 tons. The belt is driven at 325

ft. per min. by a 25-hp. motor, and the flight conveyor at 100 ft. per min. by a 20-hp. motor. With the equipment described the 1500-ton bunker can be filled in about eight hours.

Bunker Feeds Self-Unloading Barge

The coal bunker is 150 x 29 ft. and 53 ft. high. It is of timber construction and supported on piles. The floor has a wearing surface of 1-in. maple lumber, to provide a smooth lining and permit of easy repairs. The floor slopes 45° to the river side, which has two sets of chutes by which the 1500 tons of coal can be delivered to the barge in about 1½ hours. The chutes and gates are operated by the crew of the barge. There are also chutes for delivery to cars or wagons if this should be necessary.

The 1500-ton hopper barge which is used to deliver the coal to the power stations is 200 ft. long, 34 ft. wide and 14 ft. deep. The hold has a false bottom forming two longitudinal hoppers. These discharge the coal upon two belt conveyors, which deliver it to two elevating conveyors. These in turn discharge it upon a single 36-in. rubber-belt conveyor mounted upon a 50-ft. boom above the deck. This boom can be revolved to deliver the coal on shore at a distance of about 50 ft. and a height of 26 ft.

The coal can be unloaded in this way at about 200 tons per hour. The 65-hp. motor driving the hold conveyors and 20-hp. motor for the boom conveyor are supplied with current by means of electrical connections at the power-house dock.

Layout of the Plant

In laying out the plant for economic utilization of the space available the location of the bunker was adapted to the length of the barge already in use. Its capacity was determined by that of the barge, and its height was made sufficient to allow for a 45° slope to the barge when lying empty at the dock. The crusher was located at such a distance as to give a 22½° incline from the boot of the elevator to the top of the bunker. This was considered about the steepest angle practicable for the belt conveyor handling coal.

In laying out the tracks, dummies of engines and cars were shifted on blueprint plans to insure close spacing of tracks with ample clearance for switching movements.

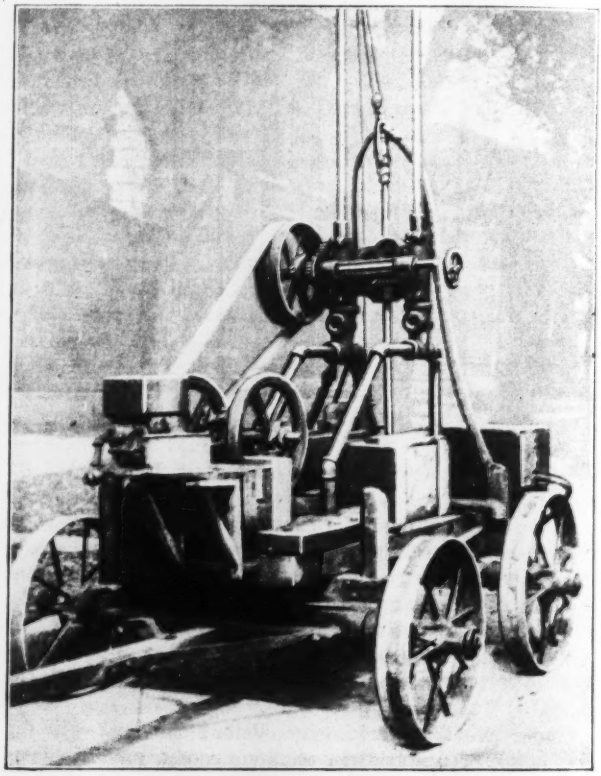
Wooden Ship Construction Taking Large Amount of Pine

Fifty carloads of Southern pine a day are being moved from Southern mills to points where wooden ship construction is under way, according to the Southern Pine Association. During the last two weeks of August fifty additional mills were put to work on timber orders for ship specifications, and many more plants are understood to have taken up business of this sort since. Two district production officers under the local purchasing agent of the Emergency Fleet Corporation at New Orleans have been appointed to determine the exact facilities of the Southern mills for producing ship material and the quantity which they can be expected to furnish.

Samples of Completed Pavements Taken with Core-Drill

Outfit Simple To Handle, Cheap in First Cost and Gives Specimens from Which Valuable Data Can Be Secured

THE practice of taking samples from completed roads or streets, and making thorough laboratory tests—such as microscopic examinations, accurate measurements of their thickness, abrasion resistance, and the like—is an approved method of inspection and research, but the reliability of the information gathered depends largely upon how the samples are taken. Quite recently a series of tests of street pavements were made in the City of Des Moines, Iowa, by the Iowa State Highway Commission, employing a Calyx core-drill outfit equipped for extracting 4½-in. diameter cores. This has proven to be superior to the usual method of employing a gang



OUTFIT OPERATED BY ONE MAN

of men equipped with chisels, sledges and picks. Through the courtesy of J. H. Ames, bridge engineer of the commission, the following description of the work is presented.

Outfit Operated by One Man

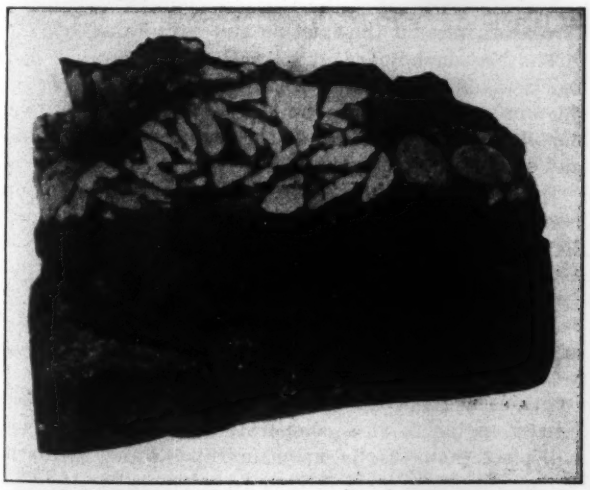
In this particular case the Calyx drill was mounted on a low-wheeled truck and belted to a 1½-hp. gasoline engine. The drill, employing chilled steel shot as the cutting medium, utilizes water for flushing the cuttings from the hole. As most of the work was done on city streets the necessary water supply was obtained by hose

from the nearest hydrant, though in one case, where this was not possible, a sprinkler wagon served the same purpose. The entire outfit was operated by one man, and beyond the expense for gasoline and oil for the engine, the pay of this man was the only expense incurred in extracting the samples mentioned hereafter.

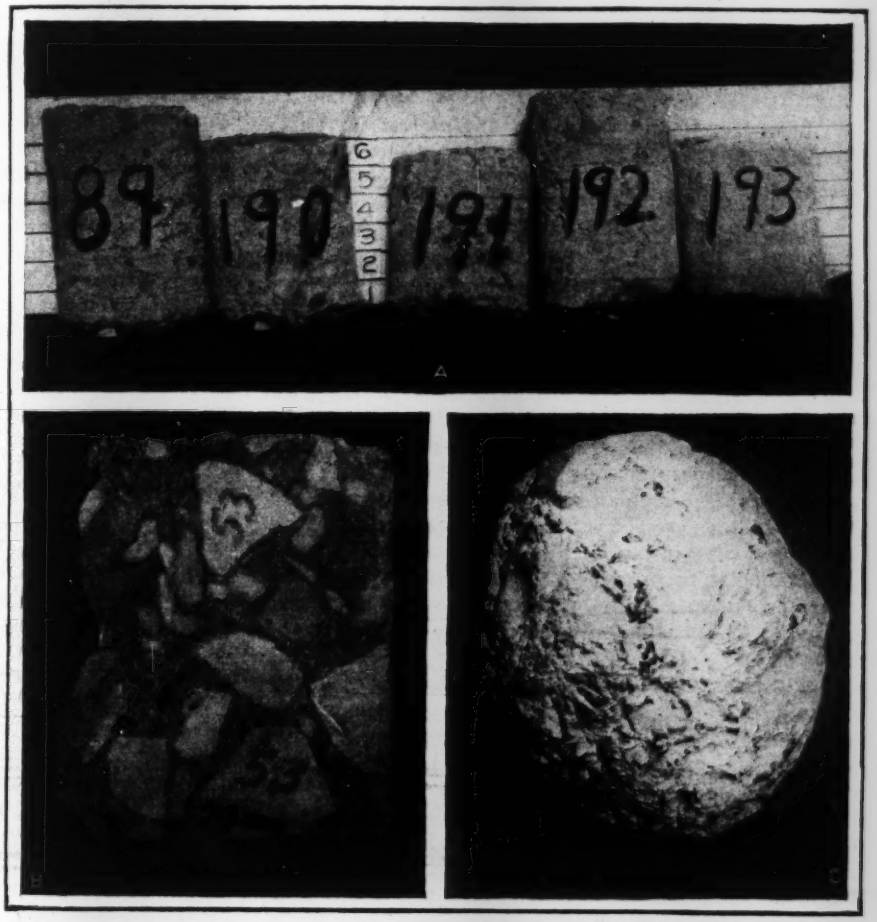
Takes 12 to 15 Cores a Day

Several hundred 4½-in. cores were taken from concrete, brick, sheet asphalt, bitulithic and asphaltic concrete streets. The rate of progress was considerably faster than the practice employing hand power. On concrete pavement varying from 6 in. to 8 in. in thickness, it was found possible to take out 12 to 15 cores per day. On other pavements 8 in. or more in thickness, where the concrete was composed of a gravel aggregate, it was not possible to maintain this speed, and the production varied from 6 to 7 cores per day. The outfit was also tried in grout-filled brick pavement, and where the grouting material was of sufficient strength to hold the pieces of brick together during the cutting operation, entirely satisfactory cores were secured. In some cases, on the other hand, where perhaps an inferior quality of cement grout was used, the machine could not be employed.

All cores removed in these tests were carefully boxed and shipped to the laboratory at Ames for examination.



TAKES CLEAN SAMPLE OF ASPHALT TOP AND BINDER



SAMPLES CHECK DEPTH OF FOUNDATION AND CAN BE SPLIT FOR EXAMINATION OF COMPOSITION OR BE TESTED IN A BRICK RATTLER FOR COMPARATIVE TOUGHNESS VALUES

A special machine at Ames cut the cores in halves and quarters, as shown in one of the illustrations. This permitted microscopic examination of the concrete and accurate measurement of its thickness. A sample taken from a sheet asphalt pavement laid over a binder course is shown, and indicates the thickness of the asphalt as well as the possibility of extracting a representative sample intact.

Cores Can Be Tested

At the laboratory, a standard abrasion machine was provided for subjecting the cores to a test similar to the rattler test employed for testing paving brick. Although there is no recognized standard of test for concrete samples, valuable information was secured which indicated the comparative values of different types of pavements. When further supplemented, this data may prove of very definite value.

Such an equipment greatly simplifies the work of extracting unmutilated samples of a size convenient for testing. The damage to the pavement is restricted to a very small area which can be cheaply repaired. The cost of such an outfit is within $600.00 and the expense is lower than that of hand sampling. The particular equipment used in these tests is made by the Ingersoll-Rand company.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Engineers Need to Assert Themselves

Sir—The writer was very much interested in the editorial appearing in your issue of Aug. 9, p. 242, under the title of "Structural Engineers Need To Assert Themselves," in whch you suggest that "engineers should become active members of local associations of commerce and thus establish personal relations with men in commercial and industrial lines."

Approximately 25% of the population of the United States reside within areas governed by more or less efficient building regulations. Approximately one-third of the buildings erected within these areas are subjected to a fairly rigid inspection during construction. In the areas occupied by the remaining 75% of the population there are practically no restrictions as to design or character of construction used, so that, as a matter of fact, probably 90% of the structures erected in the United States at the present time are built without the advantages which are derived from the services of capable and experienced engineers and are therefore not economically, and in many instances not safely, constructed.

In the areas subject to building regulations, probably one-third of the buildings are designed by architectural firms who employ architectural draftsmen, structural engineers and equipment engineers and so produce a coordinated whole, meeting all requirements of utility and economy as well as of artistic effect. In the areas not subject to building regulations, probably 5% of the buildings are designed by architectural firms of the character above described.

Some 70% of all the buildings erected are designed by so-called architects who have received no technical training, do not know the value or necessity of engineering assistance, and in most cases have no other architectural ability than that required to plan or group a certain number of rooms on a certain number of floors, clothing the exterior of the combination with a medley of ornamentation, copied from trade publications or other similar sources. This type of architect in most instances secures his commission for the design of buildings through political, social or fraternal affiliations.

Having received the commission to design a building, he simply plans the rooms, etc., required, groups them together into a building symmetrical or otherwise and works up elevations to suit. At this point the commercial man steps in. If a steel frame building, the structural work is designed probably by some structural shop which expects to secure the contract, the design being usually such that it can be modified to the benefit of the designer after the contract is let. If a reinforced-concrete structure, the design is furnished by some concern having either reinforcing steel or some "system" for sale, and is made, of course, to favor the designer. In the matter of heating, complete plans are furnished by manufacturers of heating specialties (probably some special valve or special trap), the design as usual being made in favor of the designer. The same applies to ventilation, sanitation, artificial lighting and practically every other item required to complete the building. Consequently, buildings so designed must of necessity lack economy and true efficiency, the owner having to pay for the multiplication of designs as well as for the lack of coördination in the general design.

Accompanying such plans are ambiguous specifications, copied in many instances from specifications for entirely dissimilar buildings, full of vague terms and entirely lacking in definite detailed description of the actual work to be done. The drawings and specifications are issued without complete definite working details, leaving the contractor to guess at the meaning; and it is simply a matter of good judgment on the part of the contractor as to whether he or the owner pays all the extra cost entailed by the use of such plans and specifications as are furnished by this class of architects. It is not only on small work that this class of architects finds employment, but often on large and costly structures, especially those of a public or semi-public character.

Building committees having charge of the erection of public or semi-public buildings are not usually selected because of their knowledge or fitness; they may have been good subscribers or they may be good politicians or well placed socially, but as a rule they appear to know somewhat less about the work they undertake to supervise than does the ordinary average layman. Consequently, the choice of an architect, the selection of plans and the consideration of such matters as construction, heating, lighting, ventilation, etc., are matters of guesswork or subject to the decision of the architect and the special coterie of tradesmen or mechanics who design and perform the work for the so-called architect.

To such men as usually form these building committees, and also, unfortunately, to the general run of owners or prospective owners of buildings, the word "engineer" has no meaning. Speak of an engineer and they will have in mind either a land surveyor or a man who operates a locomotive engine, a stationary engine, a traction or threshing engine or a steam roller—or probably the janitor who, in addition to his duties generally, looks after the heating plant in a building. How shall we alter the existing state of affairs?

The National Board of Fire Underwriters has done much in an educational sense with regard to the reduction of fire risks in buildings, but little has been done to educate the public to the requirements of proper and economic construction.

In some states, laws have been passed and are supposedly enforced which require that no man shall practice architecture unless he is a certified and licensed architect. There is also some agitation to secure similar laws with regard to certain classes of engineering. Such laws, however, do not reach the root of the matter and are of practically no effect. Anyone who can secure a commission for architectural or engineering work can easily secure the services of licensed architects or licensed engineers at a comparatively small salary who will place their stamps upon anything which is turned out of the office, good, bad or indifferent, for the sake of earning their daily bread. The writer has hired a

number of such men at various times, chiefly for the purpose of having them place the formal stamp upon drawings made by other more capable and efficient men —which drawings in many cases were absolutely beyond and above the understanding, comprehension, or technical education of the men who handled the stamps. Furthermore, a carpenter who designs a house, or a builder who designs a factory, can usually, upon payment of $5 or $10, get a stamp placed upon his drawings, making them legal, irrespective of any lack of structural design. Consequently, such laws do not protect the public nor the property owner.

In order to correct existing conditions, to give engineers their due and to give the public the benefit of the services which engineers are ready to render, it is necessary to get the facts as they exist before the public.

Among the means which can be used in bringing together engineers and those who would benefit from the use of their services, the writer would suggest:

1. Enlargement of the scope of engineering extension departments in our state universities and other educational institutions so as to bring to the attention of public bodies, such as boards of county supervisors, boards of education and building committees for schools, public libraries, churches, institutional buildings, etc., as well as manufacturers and those proposing to build mercantile or amusement buildings, the fact that competent engineering services are necessary to insure the economic, safe and satisfactory construction and equipment of such buildings, and that the employment of a competent engineer would prevent errors, costly changes in construction and equipment, and big bills for extras, as well as securing the lowest possible bids for construction in the first instance.

2. Coöperation between the agencies above mentioned, the various engineering societies, practising engineers, and all who are interested in the engineering profession, all working together and working hard until safe and sane building regulations are made state laws, insuring safe, sanitary and economic construction throughout the whole country.

3. Publicity—By making known the facts and conditions existing, through the public press, through such journals as reach and are read by those most interested —even by the daily newspapers, if necessary. Subscribers to professional and trade journals are usually interested only in matters pertaining to their own business or profession. Hence, it is practically impossible to reach the persons who most need the information, through these channels. A manufacturer in looking through his particular trade journal will note the market price of materials required in his business, and will probably read articles affecting methods and processes of manufacture in his line of business, but even though he were considering the construction and equipment of new factory buildings, he probably would pass over any article devoted to the description of similar buildings and the engineering achievements in connection therewith. Unfortunately professional and trade papers, especially from an engineering point of view, reach only those who have services to sell, and do not reach those who need such services.

4. As much attention on the part of educational institutions "manufacturing" engineers to the education of the general public in the matter of benefits to be obtained from the services of engineers as they pay to the matter of securing students. Also in order to improve the standing of the engineer, it would be better for engineering schools to employ higher grade, more experienced teachers, and to increase the work necessary for graduation of students so that advertisements for $800-a-year engineering instructors and $60-a-month graduate engineers will disappear from our trade journals and daily newspapers. INGENEUR-CONSTRUCTOR.

Kansas City, Mo.

Hydrated Lime in Field Concrete

Sir—I have read with a great deal of interest your abstract of my paper on the effect of hydrated lime on the strength of concrete, as published on p. 328 of your Aug. 16 issue. I presume this was taken from the *Transactions* of the National Lime Manufacturers' Association, although you do not state the source.

I am very glad to note that all of the facts have been stated correctly, and that you have included all of the necessary precautions as to the interpretation of those facts. It is unfortunate that your abstract conveys an impression almost diametrically opposed to the idea I had in mind. This idea was brought out more clearly in the discussion than in the paper, and it is quite possible that the discussion was not bound with the paper when the latter was published.

One must conclude, from the abstract, that hydrated lime causes a diminution of the strength of concrete. This is certainly shown by our laboratory results, but our field work and observations indicate that this may not always be true—in fact the truth is frequently just the opposite. Hydrated lime as used in practice may cause an increase in the strength of concrete.

The connecting link between laboratory and field results is still undetermined, but is probably the workmanship factor. Under these circumstances, it is unfortunate to promulgate laboratory results for the information of the general public, when these results are frequently refuted by practical experience.

Riverton, Va. WARREN E. EMLEY.

Thinks Segment Block Unjustly Blamed

Sir—In the title of the article by S. U. Misner, "Segment Block Sewer Fails," on page 202 of your issue of Aug. 2, we believe that you have featured the segment block too prominently. The author says that the failure was due to a common occurrence in sewer work; that is, the use of a trenching machine and the attendant careless omission to shape the bottom of the trench to receive and thus provide a good foundation for the invert of the sewer. Incidentally, Mr. Misner lays the responsibility on the flushing of open joints with a poor mixture of cement grout.

The headline "Segment Block Sewer Fails" leaves in the mind of engineers, especially the casual reader, the impression that segment sewer tile is a good construction to avoid; whereas the fact is that any type of construction would have failed under similar trying circumstances. G. R. ROBIE,

Sales and Advertising Department,

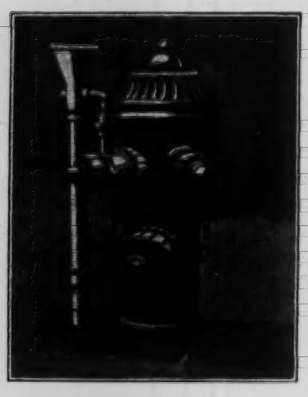
Pittsburgh. National Fire Proofing Co.

THE ENGINEER IN FIELD AND OFFICE

A DEPARTMENT DEVOTED TO DETAILS OF THE DAY'S WORK

Drinking Fountain Attached to Hydrant

A STREET drinking fountain supplied from the hose connection of a fire hydrant at Galion, Ohio, is shown by the accompanying view, in which the small vertical pipe at the left supports the fountain and serves as a waste connection to the sewer. The supply line is tapped into a nipple screwed into one of the two hose outlets. This arrangement necessitates the main valve of the hydrant being kept partially open—enough at least, to bleed sufficient water for the fountain. A self-draining hydrant, unless accurately adjusted, might waste considerable water if adapted to this scheme, and in any case a valve, too far opened, would have to be closed before steamer connections could be made to the hydrant.



DRINKING FOUNTAIN ON FIRE HYDRANT

Heavy Storm Tests a Storm-Water Drain

A STORM which tested the capacity of the new Madison Avenue storm-water drain at Ogden, Utah, when it was barely completed, gave the engineer a chance to check up his calculations of run-off assumptions The sewer drains a steep area of 1210 acres, with grades from 2 to 10% but averaging 4%. The area is laid out in city blocks, but only one of the streets is paved, though all have gutters. The calculated run-off was based on 0.21 cu.ft. per acre for paved and improved residential areas, and 0.07 cu.ft. per acre for unpaved areas and present conditions. The calculations gave 84 sec.-ft. for present conditions, and the amount measured was 70 sec.-ft. One inlet was not complete, and it was estimated that from 15 to 20 sec.-ft. went by this one inlet.

The storm occurred at an unusual time of year, July 28, and amounted to 2.2 in. in 12 hours, although most of it fell in two hours. It is considered as intensive a rainfall as has ever occurred in the Ogden district. The calculations were based on U. S. Geological Survey assumptions of rainfall which state that the intensity in inches per hour for a 30-minute period had never between 1875 and 1915 reached a rate of 1 in. per hour. The engineer used 0.4 in. for 30 minutes.

There are three sections of this rectangular drain. The total length is 4914 ft. and the largest section is 3½ x 4 ft. It empties into the Ogden River to the north, ending in a V-shape channel in which measurements were taken. The slope is such as to give velocities when running full of from 4 to 7 ft. per second.

Entrance into the drain is through vertical openings along the gutter, 12 in. high and 16 ft. long, with grate bars spaced 12 in. c. to c. These openings, one on each side of the street, were able to take the run-off from areas of approximately 80 acres each. Blocks in Ogden are in 10-acre plats, the original idea being that each man should have an acre of land and 132 ft. frontage. The streets in this section are mostly 55 ft. between curbs. The future paved area will be cut down in many streets to 35 ft. between curbs with wide parking at the sides.

A sanitary sewer system for the section north of the Ogden River is being designed, and information as to flow is being obtained by a Stevens continuous-flow recorder placed on the outlet of the present sewer. It measures the head on a 9-ft. rectangular weir. This volume will be added to that of the district planned, and will be taken out of the Weber River and discharged at a point seven miles down stream. The new system provides for a maximum daily flow of 175 gal. per capita, plus 10 sec.-ft. for ground-water infiltration.

The contractor for the drain, which cost $25,000, was the Gibbons & Reed Co., of Salt Lake City. The design was made and work carried out under the direct supervision of Joseph M. Tracy, city engineer.

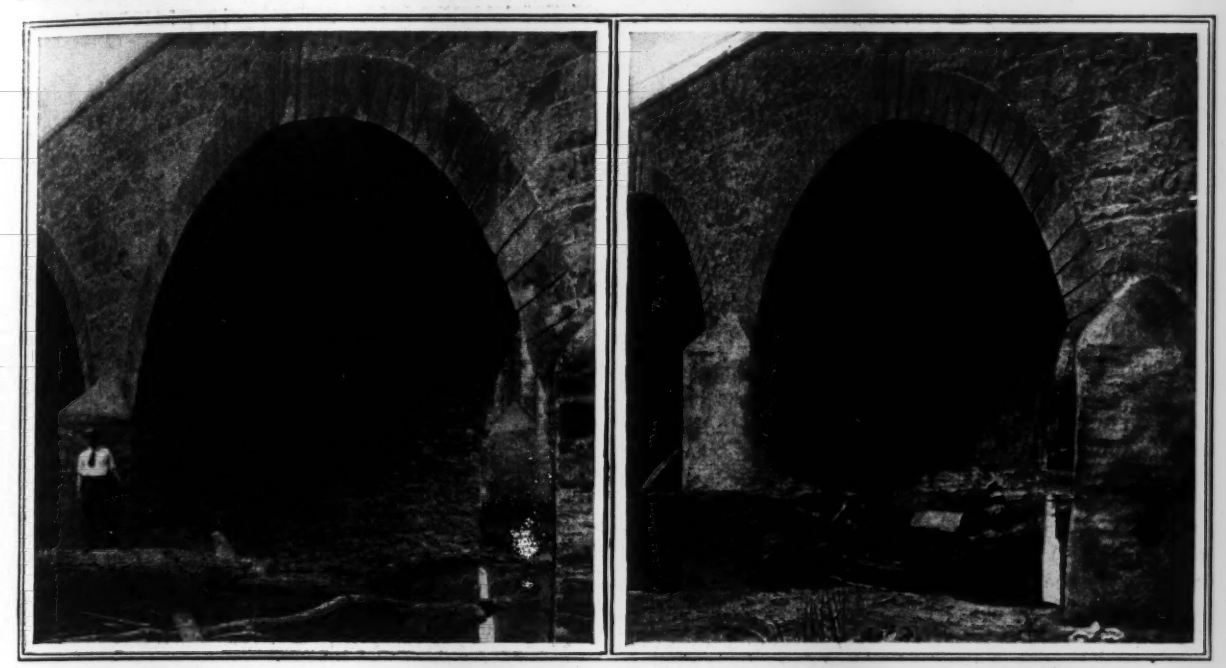
Century-Old Stone Bridge Covered with Cement-Gun Mortar

BY R. L. KELL
Assistant Engineer for F. H. Shaw, Consulting Engineer, Lancaster, Penn.

TIME and the elements have made their impression on the historic Witmer's Bridge built in 1800 across Conestoga Creek, about ½ mile east of the city limits of Lancaster, Penn. The mortar on the under side of the nine rubble masonry arches, which vary in length from 23 to 35 ft., had disintegrated and fallen out to such an extent that repairs were imperatively needed to preserve the structure. As a means of obtaining permanent repairs and preserving the quaint character of the old bridge, the cement gun was felt to offer the best opportunity. The specifications for the work provided that the old, loose mortar should be picked out of the joints, that the surfaces to be coated should be covered with 3-in. triangular wire mesh, securely fastened to the face of the masonry with boat spikes, and that all holes should be shot solidly full with 1:3 mortar. The surface was to be coated with 2 in. of mortar.

The photographs herewith show the arches before and after the application of the gunite. The mortar was left rough, as being more in keeping with the type of bridge than a troweled finish. The work was done in such a manner that a solid casing of cement mortar lines the arches, no hollow spots being detected in an inspection with a hammer.

The specifications were drawn by F. H. Shaw, consulting engineer, of Lancaster, Penn., and the work was



OPEN JOINTS IN THE OLD BRIDGE SHOWN ON LEFT WERE PLUGGED WITH GUNITE AS SHOWN ON RIGHT

carried on under his supervision. The contractor was the Dewey Cement-Gun Construction Co., of Allentown, Penn. The work was completed in fourteen days of actual shooting, approximately 11,000 sq.ft. of surface being covered.

Early Tests Show Slag To Be Good Concrete Aggregate

A SERIES of tests upon the availability of air-cooled blast furnace slag for concrete aggregate have been undertaken by the Pittsburgh Testing Laboratory, Pittsburgh, Penn. Reports are now available on compression tests on 8 x 16-in. cylinders up to six months. The full test period will be five years and it will be that long before the durability studies will be complete. As to strength, however, the earlier tests should be nearly as conclusive as the long-time tests.

The purpose of the tests is to furnish a comparison of the crushing strength of concrete made from slag, from crushed stone, and from gravel, to determine the granulometric analysis of the slag and the corrosive tendency of sulphur upon reinforcement, and finally to compare the relative strength and durability of concrete made from high magnesia slag as compared with high lime slag.

The slag was obtained from a number of different slag companies. In some cases it was fresh slag and in others material which had been in the bank from six months to 15 years. Comparisons were made with concrete, made with gravel, trap rock and limestone. The slag was crushed and graded from ¼ to 1½ in. and was combined for the aggregate in equal proportions of the four gradings, ¼, ¾, 1 in. and 1½ in. It was weighed according to a standard method of filling a cubic foot measure loosely and dropping 10 times on a felt pad 1 in. thick from a height of 3 in., the measure being filled and smoothed to a straight edge after the impact. An average of 10 determinations was taken of the weight per cubic foot of material used, and the variation of the individual determinations was usually within ½% and seldom over 1%. After considerable study of maximum density it was found that an ordinary 1:2:4 volumetric mixture of cement sand and coarse aggregate would give optimum conditions.

The compression results on the 8 x 16-in. cylinders for the 14-day, 30-day, 60-day and 180-day tests are available. They show very little variation between the different slags and the other aggregates; so little in fact that no very definite distinction as to strength can be made. The engineer of tests of the Pittsburgh Testing Laboratory, P. I. Freeman, however, makes the following summary of the results after the six months' investigation:

"One-half the tests of the slag concrete were made using slag produced by the quick cooling process, in pits, in which the slag is shipped within a few days from the time it comes from the furnace, and the remainder from slag which has been seasoned in banks from a period of six months in some cases to as much as 15 years. The length of time during which the series of tests have been conducted does not warrant the drawing of any definite conclusion, but the general uniformity of the results from the crushing tests of the concrete should be observed. Slags coming from furnaces many hundred miles apart, varying quite widely in chemical analysis, and also varying considerably in the weight per cubic foot do not vary in strength in proportion to either the weight or percentage of any chemical constituents."

It is of interest, however, to note that the slag weight per cubic foot runs between 64.5 and 83.8 lb., with an average of 73 lb., as against 95 to 104 for gravel, 90 for crushed granite, and 94 for limestone.

Cost of Motor-Car Service for Field Parties on Surveys

FIELD parties surveying the areas for flood-control reservoirs near Columbus, Ohio, had headquarters in small towns, as farm-house accommodation was not satisfactory. Three Ford automobiles without beds were purchased by the Franklin County Conservancy District. These were filled with special beds having two seats, a canopy top and curtains, a box on the side to carry level rods and sighting poles, and a lock box for equipment and lunch. The cars cost $510 each, complete.

Records of operating cost were compiled only for one car. This car ran 5500 miles and made an average of 21½ miles per gallon of gasoline, or at an average cost of 0.9c. per mile for gasoline alone. Including repairs, punctures, tire renewals, a garage rental of $3 per month, etc., the total cost of operation, exclusive of interest and depreciation, amounted to 3⅜c. per mile. Assuming a life of four years, interest at 5%, and a mileage of 6000 per year, the total cost per mile would be 6.2c. As the average distance covered by the parties in going to and from work was about 20 miles, the average cost of transportation, including interest and depreciation, was about $1.25 per day. This should be compared to $1.50 per day for horses and wagons, and does not credit the time saved.

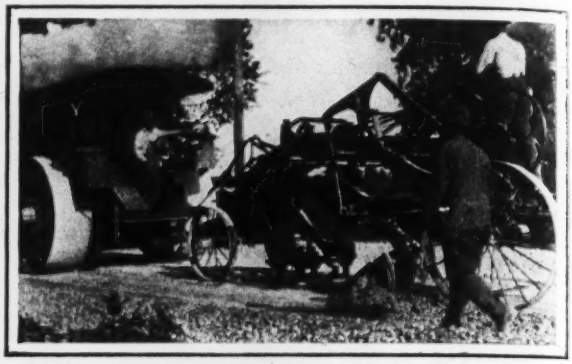
Macadam Road Is Surfaced as Base for Concrete

SURFACING and leveling the present macadam to serve as the subgrade for new paving, and the use of a special grader for this work, are features in the improvement of a main road in Cook County, Illinois. The road will have a concrete base 4 to 6 in. thick, and a 2-in. asphalt surface. This will be 18 ft. wide, with a 3-ft. macadam shoulder on each side.

The old macadam is 6 to 15 in. thick, badly rutted and very hard. Beneath it is a still older gravel paving. It was desired to level the surface, but to avoid breaking up the macadam, as it forms an excellent subgrade. The hardness of the surface, however, made this a difficult problem, as a road grader could not cut the macadam. Successful results were obtained by the use of a new machine combining a gang rooter or scarifier and the ordinary scraper blade of a road grading machine.

The rooter is mounted behind the front axle of the machine, as shown in the accompanying view, and has five teeth of hardened steel 1½ x 3 in. They are set 10 in. apart (in a staggered row) so as to make a cut 40 in. wide. They can be raised, lowered and tilted to any desired angle. Behind the rooter is a 9-ft. scraper blade. This machine was built by the Austin Manufacturing Co., of Chicago.

On this work the machine is hauled by a Reeves steam traction engine. It goes down one side of the road and back on the other, making as many cuts as may be necessary for the required depth. The rooter is set for a depth of 4 in. on the first cut. The scraper blade levels the surface and throws the excess stone out on either side, to be used later for the shoulders. The machine leaves the subgrade practically ready for the concrete, very little correction or final dressing by hand being required.



COMBINED ROOTER AND GRADER SURFACES OLD MACADAM SUBGRADE FOR CONCRETE

The working force comprises two men on the traction engine, one on the grader and one to drive the tank wagon for supplying the engine with water. This road is a 9-mile extension of 95th St., beyond the city limits. Its improvement is under George A. Quinlan, county superintendent of highways. The contractors are John A. McGarry & Co., of Chicago.

Water-Soluble Calcium Oxide Determined by Sugar Solution

THE following is the method in use in the laboratory of the St. Louis Water Department for the determinations of the water-soluble calcium oxide in quick lime. Approximately 7 grams of lime, contained in a weighing bottle, are dumped into a liter flask containing 500 c.c. of a sugar solution (160 grams per liter). Caking is prevented by causing a whirling of the solution while the sample is being added. The flask is then put on a Camp shaking machine and shaken for 30 minutes. It is then made up to the 1000 c.c. mark with carbon-dioxide-free distilled water, shaken by hand and allowed to stand overnight. Twenty cubic centimeters of this solution are then titrated with tenth-normal hydrochloric acid, using phenolphthalein as the indicator, and the per cent of lime determined. The addition of acid is continued until the first disappearance of the pink color. The color reappears in a short time, but the first disappearance is taken as the end point.

Urges Short, Level Stretches Both Sides of Grade Crossings

The use of short, level stretches both sides of railroad-and-highway grade crossings is urged by George S. Eaton in the *Concrete Highway Magazine*. At many crossings where the railroad is on fill there are short, deep grades running up to the very rail. It is pointed out that automobilists, in attempting to get up these grades on "high" and at the same time avoid bouncing over the rails at a high rate of speed, frequently stall with the front wheels on the track, and are struck before they can get away. With a level section of 30 ft. each way from the track, or outside of the outer tracks where there are more than one, any stalling would take place clear of the track.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Steam Jets Thaw Three Feet of Hard Frost in 15 Minutes

By H. P. J. Earnshaw
Contractors' and Roadbuilders' Equipment, Boston

THIRTY-FOUR inches of frozen clay, so hard that stones embedded in it could be cut off without loosening them at all, which was encountered on a recent excavating contract, was readily thawed by the method shown in the photograph, which was devised by the writer, who furnished the Erie shovel used on the job by the Boston Excavating Company.

It was impossible to lift or break this frozen crust, and ordinary means of thawing, such as steam pipes under canvas cover, and live steam under canvas cover, proved such a failure that only 4 or 5 in. were thawed out in 36 hours. The plan used was to jet holes with an open-end ½-in. pipe connected to the boiler by a ½-in. hose, the steam pressure quickly melting a hole in the frozen clay and forcing pebbles and small stones out of the way. As fast as these holes were made a ½-in. capped pipe with four ¼-in. holes bored in it was put in each and left running to thaw out the ground. These pipes, one of which is being held ready to insert by a man at the right in the photograph, were connected in series by short lengths of hose to steam lines run from the boiler. Twelve of these were put in at a time, connected to one line. These were moved back as the shovel worked toward them, requiring only 15 minutes to thaw out a section of the bank so thoroughly that the revolving shovel could dig it as well as if it had never been frozen.

Fifty-Seven-Foot Concrete Pavement Finished with Long Belt

CONCRETE pavements 57 ft. wide were floated with a belt successfully in Ogden, Utah, early this season. The belt was 59 ft. long and handled easily by two men, who went over the road at least twice after the surface was struck off.

In striking off the pavement a row of stakes, 10 ft. apart, was driven down the center line to finished grade, and on these a channel iron was placed to support one end of a strike board templet for one-half the street. The center end was operated from a bridge which was mounted on wheels and easily pushed along.

Reinforcing of triangle mesh was placed 2 in. below the surface, and ½-in. felt expansion joints were inserted every 60 ft. Although there is as yet no pushing, the city engineer is of the opinion these should be at least ½-in. thick. No cracks had appeared in these large slabs in the two blocks laid last fall or three blocks laid this spring.

The work was done under the supervision of Joseph M. Tracy, city engineer, by J. P. O'Neil, contractor.

TWO DOZEN HALF-INCH STEAM JETS THAW THREE FEET OF HARD-FROZEN GROUND FASTER THAN SHOVEL CAN EXCAVATE

HARDAWAY CONTRACTING COMPANY

If presented within thirty days this becomes a sight draft on
THE NATIONAL LOAN & EXCHANGE BANK
OF COLUMBIA
but will not be paid unless the properly receipted invoice or invoices listed below are attached hereto:

Voucher No. _____ Month _____

Pay to _____ Columbia, S. C. _____

_____ $ _____

HARDAWAY CONTRACTING COMPANY
COLUMBIA CANTONMENT ACCOUNT

CHECKED: _____

By _____

DISTRIBUTION	DESCRIPTION OF ACCOUNTS
_____ 1917	

FORM BECOMES SIGHT DRAFT WHEN ATTACHED BILL IS RECEIPTED BY OFFICER OF MATERIAL COMPANY

Must Receipt Bills in Order to Get Money

THE cantonment division of the quartermaster general's office requires that all bills for material paid by the contractor must be receipted by an officer of the material company concerned before the contractor will be paid for them by the Government. Contractors who have handled percentage work on which receipted sets of bills were required by railroad companies or other owners will appreciate the difficulty of getting such signatures out of the officers of lumber companies and material concerns. The little form shown in the illustration, however, overcomes this difficulty and brings back the original bill, receipted by an officer of the company, every time.

The form, which was devised for this purpose by Charles Neville, of Charles Neville & Co., which firm is handling the accounting work for the cantonment at Columbia, S. C., dispenses in the first place with all payment by check. The form itself is a sight draft on the bank account of the contractor. The proper receipt on the face of the original bill for the material is made the indorsement necessary to enable the material firm to cash the sight draft. These drafts, with the receipted bills attached, are returned to the contractor with the next bank statement in the same way as any other sight draft. They are taken care of on the contractor's books in the usual manner.

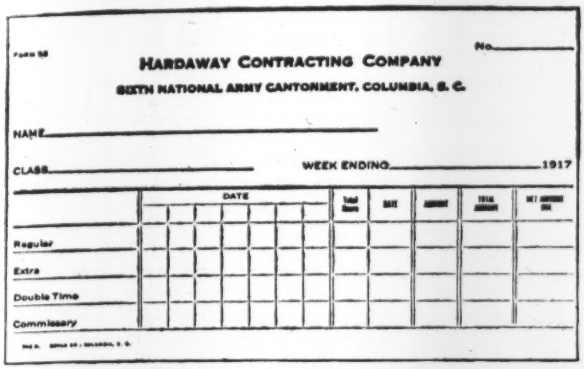
This form, which forces a proper receipt automatically before any payment can be collected, enables the Government to reimburse the contractor promptly for all material charges paid out on the work.

Nine-Thousand-Man Payroll Made Up in Sections

THE payrolls at the National Army contonment under construction near Columbia, S. C., described on p. 497 of this issue, are made up from the cards as shown in the illustration, one of which is kept for each man who has worked during the week. The men's numbers are entered on these cards, and each "inside" timekeeper has a group of 500 such cards, numbered for the batch of men for whose time he is responsible. These men receive their checks from this man, are checked up on the work by this man's outside timekeeper, and are paid off once a week by the contractor's paymaster. The cards are kept in a regular card-index drawer, and each day every one of the 500 cards is brought up to date. No other record is kept until the time comes to make out the payroll, when the cards are gone through in order and the time entered on the payroll form, which corresponds to the card except that there is only one line for each man. The cards and the payroll are totaled separately on adding machines by groups. The time is closed on Wednesday night, the roll made out and checked, the change list made, the money brought up from the bank, and the envelopes plugged in time to pay off at 4 p.m. on Saturday. The working day on Saturday is cut to eight hours for this purpose, as the men in many instances have so far to travel to reach the pay office after leaving their section of the work that if a full day were worked it would not be possible to get them back to the city until a late hour. On this account, before payday was

shortened to an eight-hour working day, the workmen in outlying sections began to desert their posts about noon, and by three o'clock in the afternoon the work would practically be suspended. This was only allowed to happen one payday before the present system was installed.

As there are more than 9000 names on the payroll each week, 25 or 30 windows are used in paying off


HARDAWAY CONTRACTING COMPANY
SIXTH NATIONAL ARMY CANTONMENT, COLUMBIA, S. C.
NAME
CLASS
WEEK ENDING 1917
DATE
Regular
Extra
Double Time
Commissary

EACH MAN HAS TIME CARD

groups of 500. The head timekeeper handles personally all complaints about the time, taking each matter up with the individual timekeepers concerned. The system is used by Charles Neville & Co., which firm is in charge of accounting under Maj. William Couper, constructing quartermaster.

Handy Wood Twister for Form Wires

By John E. Langley
Huntington, W. Va.

THE WOOD twister shown in the photograph has proved a handy tool on many jobs for tightening form wires. It is made of a piece of 2 x 3 in. hardwood about 14 in. long, the ends of which are smoothed for handles. Two holes are bored symmetrically through the 3-in. dimension of the stick about 4 in. apart with a 1-in. bit. The ends of the wires to be twisted are put through these holes and bent over, the twister being held about 6 in. from the face of the form or the top of the beam. The wires can then be drawn tight very quickly, making a secure and satisfactory job.

TWISTER DRAWS WIRES UP EASILY

Paving Mixer Charged with Measuring Boxes Dumped by Chain Hoist

IN MIXING the concrete for building roads this season B. F. Batchelder, chief engineer of the Portage County Improvement Association, Ravenna, Ohio, has adopted a method of transporting measured batches from a central loading plant in boxes which are dumped into the loading skip in a chain hoist on the mixer. These boxes hold 13½ cu.ft. or one mixer batch.

For transporting the boxes from the central loading plant to the mixer, a 3-ft. gage industrial railway is used. Each industrial railway car carries four of these batch boxes. The locomotive spots them in front of the

HOIST LIFTS BOXES BY LIGHT BAIL

loading bins and the required amount of sand is put into each box. The car is then shifted to the gravel bin and filled flush with the top. The train is then run out to the mixer and the boxes unloaded directly into the mixer skip by a small crane and geared chain hoist, which is fastened to one corner of the mixer frame.

The arrangement is stated to be proving very satisfactory, and with this equipment it has been possible to build as much as 380 ft. of 12-ft. concrete pavement 7½ in. thick in a 10-hr. working day with but eight men working at the mixer.

Laying an Intake Pipe for a Cantonment

A 3500-ft. intake of 8-in. cast-iron pipe in Lake St. Clair supplies water for the United States aviation camp at Selfridge Field, near Mount Clemens, Mich. For the first 1000 ft. from shore the pipe is laid in a dredged trench about 6 ft. deep. The remainder is laid on the bed of the lake, in about 8 ft. of water, and ends in an intake opening protected by a screen. The pipe is laid 6 ft. below the deepest known ice level. The laying was done by means of a gasoline launch and two lighters or scows. The pipe lengths were connected up on the scows with special couplings. These connections are strong enough to carry an 80-ft. unsupported length of pipe, but the laying was so arranged that the distance from the scow to the pipe resting on the bottom of the trench did not exceed 60 ft. The Walbridge-Aldinger Co., of Detroit, has the contract.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Jersey City Water-Supply Clean-Up Proposed

Diversion of Sewage Below Boonton Dam with Activated-Sludge Plant and Chlorination Advised

The long-drawn-out controversy between Jersey City and towns in the Rockaway River drainage area above the Boonton dam appears to be drawing toward a close, or at least to a new stage. Jersey City, on Sept. 4, asked the State Department of Health to approve general plans for a trunk sewer to divert the sewage of Rockaway Valley towns to a point below the Boonton impounding reservoir of the Jersey City water-supply, and also to give tentative approval to activated-sludge and chlorination works to treat the sewage thus diverted, the latter as recommended by George A. Johnson, consulting engineer, New York City. The department instructed Chester G. Wigley, chief of its Bureau of Engineering, to outline for Jersey City the general requirements of the department for guidance in drawing specific plans. Early action is expected.

TRUNK-SEWER WILL BE OPPOSED

The treated sewage would be discharged into the Rockaway River, a tributary of the Passaic, some miles above the intake of the Little Falls filtration and chlorination plant of the East Jersey Water Co. and allied corporations which supply Paterson, Passaic, Montclair and other communities. It has been reported that these corporations will oppose the trunk-sewer. It was proposed some months ago to extend the proposed trunk-sewer to a point below the Little Falls intake, but this would be costly and at once suggests a further extension to tidewater, as the Passaic Valley Sewerage District is spending millions to divert the sewage of all the communities on the Passaic below Little Falls.

ATTEMPT TO REOPEN SUIT

Another confusing element in the situation is a proposal to try to reopen the suit brought by Jersey City to compel the contractor for the Boonton reservoir and conduit to divert the sewage of the Rockaway towns, on the ground of non-fulfillment of the contract to supply pure and wholesome water. The contractor claimed, and was sustained by the court, that the Boonton water-chlorination plant, the first large hypochlorite plant for water treatment ever built, fulfilled this part of the contract. Jersey City has referred to a special attorney the question of the advisability of trying to reopen the suit, which for some months has been in the hands of its corporation counsel.

Joint Committee Named To Study Concrete Ships and Barges

Robert W. Boyd, consulting engineer, has been retained by the Joint Committee on Concrete Ships and Barges appointed by the American Concrete Institute and the Portland Cement Association. The members of the two committees are as follows:

American Concrete Institute—H. C. Turner, chairman; Leonard C. Wason, Robert W. Lesley, Charles R. Gow, M. M. Upson.

Portland Cement Association—E. D. Boyer, chairman; Joseph Brobston, F. W. Kelly, W. S. Mallory, S. P. Crabo.

An active investigation has been undertaken to determine the possibility of this type of construction.

Engineers Club Organize Home Guard

The Engineers Club of Columbus, Ohio, has organized and started to drill a company of the Columbus Reserves, in accordance with the ordinance passed by the City Council. The club was organized in May of this year and the fact that after four months' existence it was able to accomplish such a task as furnishing a company of 107 men is sufficient guarantee for the future welfare of the club. The company is formed from members over military age, or those exempted from service, but who are able to do guard and patrol duty. The members are serving without pay and are furnishing their own uniform.

Washington Land Exchange Halted by Enlistments

According to the report of State Land Commissioner Clark V. Savidge, Olympia, Wash., and Stanton G. Smith, of the United States Forestry Service, the enlistments in engineering regiments and the number of young surveyors and engineers who are working in officers' training camps to qualify themselves for war service has made it impossible for the state land commissioner and United States Forestry Bureau to complete the details of the big land exchange, whereby the State of Washington will receive in solid tracts the granted lands lost through inclusion in the forest reserves.

Canada Votes $7,500,000 Loan to Grand Trunk Pacific

A loan of $7,500,000 was voted Sept. 3 by the Canadian House of Commons to provide the Grand Trunk Pacific Ry. with funds for necessary betterments for another year.

Tunnel Bid 46 Per Cent. Higher Than Estimate

Contractor's Offer To Build 19-Mile Hetch Hetchy Bore for $9,224,000 Is Rejected

Bids were received Aug. 22, by the Board of Public Works, San Francisco, for the construction of 96,808 ft., or about 19 miles, of aqueduct tunnel 10 ft. 3 in. in diameter, on the Hetch Hetchy project, leading from Early Intake, 12 miles below the dam, to near the Priest's forebay reservoir above the power plant. As was announced in these columns last week, three bids were received, from R. C. Storrie & Co., Healy-Tibbitts Construction Co. and the Lindgren Co., all large contractors in the city. The detailed figures are given in the "Contracting News" section of this issue. The lowest was by R. C. Storrie & Co., as follows:

			City Engineer's Estimate
Section A,	23,725 ft.	$1,983,725	$1,458,050
Section B,	24,739 ft.	2,258,560	1,432,348
Section C,	48,344 ft.	4,991,386	3,200,215
	96,808 ft.	$9,233,671	$6,090,613
Extra work and engineering.....			216,387
			$6,307,000

The sum total of $9,233,671, bid by R. C. Storrie & Co., exceeds the city engineer's estimate by $2,926,000, or 46.4%. The contractor's bid averages $95 per foot, including accessory structures, which is regarded by the city's representatives to be excessive for a tunnel of such a small size. A larger tunnel, 12 ft. in diameter, it is pointed out, is now being driven under Lake Michigan for a distance of 5 miles under the lake at a cost of $59.80 per foot. A tunnel 8 ft. in diameter, 8700 ft. long, lined with concrete, driven by the Marin Water District, is costing $29.70 per lineal foot.

The city engineer and the Board of Public Works therefore deem the present bids excessive and on the recommendation of the city engineer the bids have been rejected by the Board of Public Works.

Various factors, such as the high price of steel, the high price of powder, and the uncertain condition of the labor market, are responsible for the contractor's prices on the Hetch Hetchy project.

It is expected inside of a month to have the rails laid into the dam site, when the ballasting of the track will be undertaken, so that the railroad will be in first-class condition for hauling materials. The city is prosecuting vigorously the completion of its power plant, so that it will have power to distribute along the line of the proposed work.

Contracts Awarded for Three Shipyards

Government Plants Will Be Located at Newark, Chester and Hog Island, Penn.

Contracts for construction of three Government-owned shipyards for building fabricated steel merchant vessels have been awarded by the Shipping Board's Emergency Fleet Corporation. They went to the Submarine Boat Corporation for a plant at Newark, N. J.; the American International Corporation for one at Hog Island, Penn., and the Merchants' Shipbuilding Co. for one at Chester, Pennsylvania.

The yards will cost $35,000,000 and the Government is given an option to purchase the lands on which they are located. The builders of the yards are given contracts for building in them 200 ships. The prospects are that contracts for many more vessels will be let when these are completed and more money is available.

The Submarine Corporation will lay ways for building 28 ships simultaneously and will have facilities and equipment to turn out one 5000-ton ship every two days after the first vessel is completed.

Close Bidding on Shandaken Tunnel

Two of three bidders for construction of the 18-mile Shandaken tunnel, New York water-supply, came within 2% of each other, as the opening of bids on Sept. 11 showed. The tunnel is a 10 ft. 3 in. by 11 ft. 6 in. horseshoe, concrete lined and grouted, in rock, and is to be constructed from light shafts. It extends from Gilboa, Schoharie County, to Allaben, Ulster County, N. Y., and will carry water from a new reservoir, on Schoharie Creek, southerly to the Ashokan reservoir (Esopus Creek).

The three bids, detailed in our "Contracting News" pages, totaled as follows: Degnon Contracting Co., $12,138,000; Booth & Flinn, Ltd., $12,374,000; P. McGovern & Co., $14,800,000. These figures apply to the entire length of tunnel. Separate bids were received from Degnon and McGovern for the north and south halves of the work, as called for by the bidding schedule.

The work is under the Board of Water-Supply, New York City; J. Waldo Smith is chief engineer.

Mobile To Have Municipal Docks

By an overwhelming majority the citizens of Mobile, Ala., voted on Aug. 13 to authorize the City Commission to arrange a bond issue of $600,000 for the construction of a municipal water terminal. The project as designed comprises concrete wharves, piers and bulkheads, railroad connections to the water front and dredging to a depth of 30 ft. Warehouses are also included in the design but cannot be built within the present appropriation.

Engineering Society Starts Weekly Bulletin

Cleveland Technical Men Undertake Unusual Venture to Intensify Interest

In introducing Vol. 1, No. 1, of *Cleveland Engineering*, a four-page weekly, the Bulletin Committee of the Cleveland Engineering Society says: "It can hardly be said that the primary purpose . . . is to stimulate interest. The society is well known as an active and live organization. So that it appears better to state our purpose as that of stimulating interest," and hopes that the publication will draw the members into a feeling of closer contact with the society.

The bulletin will carry announcement of coming events, of the activities of the society, both socially and technically, and furnish a short index of leading articles in current technical literature. The first issue lists 34 articles from 17 journals. In addition, such announcements as the chairmen of various committees desire to make to the membership will receive place, and in this connection it is interesting to note that the chairman of the Program Committee has divided his work into nine sub-committees on technical matters and three on general matters, as follows:

1—Civil.
2—Mechanical.
3—Electrical.
4—Mining and Metallurgical.
5—Chemical.
6—Architectural.
7—Automobile.
8—Military.
9—Municipal.
A—Noon-day Meetings.
B—Weekly Bulletin.
C—Excursions.

The technical sub-committees are each composed of two men who will meet from time to time with the chairman of the main committee and one or another of the officers of the society.

Cleveland Engineering will in no way interfere with the issuance of the *Journal* of the society, but is intended as a timely supplement.

Cleveland Engineering Society Names Airplane Committee

To coöperate with Cleveland manufacturers who will take part in producing on a large scale the airplane parts for use by the United States Army now in France, the Cleveland Engineering Society has named a committee, headed by H. C. Gammeter, of the American Multigraph Co. Other members of the committee are: Prof. F. H. Vose, of the department of mechanical engineering, Case School of Applied Science; James Sterling, chief engineer for the F. B. Stearns Co.; Walter Baker, president of the American Ball Bearing Co.; Albert H. Bates, patent attorney; W. R. Brewer, district representative of the B. F. Sturtevant Company.

$14,550,000 To Help States Build Good Roads

Secretary of Agriculture Announces Apportionment for Fiscal Year Ending Jund 30, 1919

The Secretary of Agriculture has announced the apportionment of $14,550,000 of Federal funds to be used in the fiscal year ending June 30, 1919, by the several states in the construction and maintenance of rural post roads, as follows:

The division of this sum among the various states is given in detail on p. 117 of this week's "Contracting News." As will be recalled, the Federal Road Act of 1916, passed by the 64th Congress, provides that after 3% of the available annual funds have been retained for a contingent fund, the balance is to be distributed, one-third in the ratio of the relative areas of the several states, one-third in the ratio of their populations, and one-third in the ratio of their rural delivery and star routes.

This is the third apportionment under the act, $4,850,000 having been apportioned for the fiscal year ending June 30, 1917, and $9,700,000 for the fiscal year ending June 30, 1918.

Septic-Process Protective League Opposes Compromise

That the lawsuit over the Cameron septic-tank patents should be continued was the decision of a meeting of the National Septic Process Protective League held at Chicago on Aug. 14. About a score of members were present, including the president, Dr. H. M. Bracken, executive officer of the Minnesota State Board of Health. The league has now 184 members scattered.

A report of the secretary, Frank G. Pierce, Marshalltown, Iowa, explained that a suit brought by the Cameron Septic Tank Co., Chicago, is now pending against Shelbyville, Ky. This city is a member of the Protective League, which has provided legal assistance. Its attorney, W. R. Lane, of Chicago, made a motion to dismiss the case, on various grounds, but the judge has recently given a ruling adverse to the motion. This is the only action that has been taken in the case. A resolution was passed in favor of continuing to render special legal assistance to the city in fighting the suit.

The report stated also that the Cameron Septic Tank Co. has made a proposition to the league for a compromise with its members, offering to make a reduction of at least 25% in its royalty claims. The members of the league are mainly opposed to such a compromise. To carry the litigation to the highest court, however, will require more money than the league can raise by the method now provided by its constitution, and for this reason the meeting was called to consider the situation. There was strong feeling in favor of carrying on the work.

Engineering Societies United by Central Council

National Groups Organized for Federal Aid; Aim to Represent Every Technical Society

The Engineering Council is a central committee of 24 men representing the four national societies of civil, mechanical, electrical and mining engineers. A lengthy official statement of its efforts and aims has been issued, the essential points of which are given in the following paragraphs:

The Engineering Council is the outgrowth of real need for united action upon questions of common concern, and the members hope that it may lead to wider coöperation in a strictly representative body for all the engineers in the country.

War has brought out impressively the actual need for united action. At present the council is supported by only four national societies, because that seemed the most practical way of getting a group together to answer the immediate needs (but the special committees already organized by the Engineering Council have in them representatives of other technical societies). These four societies have come together in pairs in the past for special purposes, but until the council was definitely organized in June there was no permanent body to advise all the societies.

The members of the Engineering Council are: For the United Engineering Society, Clemens Herschel, B. B. Thayer, I. E. Moultrop, Calvert Townley, secretary; for the American Society of Civil Engineers, John F. Stevens, George F. Swain, vice chairman; Fred H. Newell, Alex C. Humphreys, John D. Galloway; for the American Institute of Mining Engineers, P. N. Moore, S. J. Jennings, B. B. Lawrence, J. Parke Channing, Edwin Ludlow; for the American Society of Mechanical Engineers, Dr. Ira N. Hollis, chairman; John H. Barr, Charles Whiting Baker, Arthur M. Greene, Jr., Dr. D. S. Jacobus; for the American Institute of Electrical Engineers, H. W. Buck, vice chairman; E. W. Rice, N. A. Carle, P. Junkersfeld, C. E. Skinner.

Work Already Done

The first work of the Council necessarily has been its organization and the appointment of standing committees. These committees are: (1) Public Affairs, C. W. Baker, G. F. Swain, S. J. Jennings and E. W. Rice; (2) Rules, J. P. Channing, Clemens Herschel, N. A. Carle and D. S. Jacobus; (3) Finance, B. B. Thayer, I. E Moultrop, Calvert Townley and A. C. Humphreys.

As certain questions relate to the war and the assistance that engineers can render, a committee to be called the "American Engineering Service Committee" was appointed with instructions to invite the coöperation of all engineering societies. This committee in the first instance consists of A. D. Flinn, of the Civil Engineers; A. S. McAllister, of the Electrical Engineers; George J. Foran, of the Mechanical Engineers; G. C. Stone, of the Mining Engineers, and E. B. Sturgis, of the Metallurgical Engineers. Its present duty is the tabulation of the members of the five societies represented in order that the profession may take a larger part in the industries after peace is declared. At present the committee is devoting its attention to the immediate needs of the hour—the procurement of men for special service to the Government. A list of specialists in the societies has already been completed. Although a great many engineers have already entered through the engineering societies, through colleges and various special boards in Washington, the importance of a complete list of engineers and their professional specialties cannot be overrated. Such a complete list can be made only with the help of the local as well as of the national societies. The Service Committee is organized with G. J. Foran as chairman and A. S. McAllister as secretary. Communications will be sent out inviting coöperation and all societies are asked to respond.

Another committee, called the War Committee for Technical Societies, is made up of H. W. Buck, chairman; A. M. Greene, R. N. Inglis, C. R. Corning, G. C. Stone, D. W. Brunton, J. M. Boyle, J. V. Davies, Joseph Bijur, A. S. McAllister, W. D. Richardson and Charles Baskerville. It was appointed to assist any organization in Washington in any way in which it could bring to the attention of the engineers of the country the necessity for thought and help.

A Larger Council Planned

To enlarge the Council a union of all societies as the outgrowth of the present council is most natural, because many local societies and national societies also have a large membership in the four societies at present concerned. There are three classs of engineers to reach: (1) Those who are members of local societies and not members of national societies; (2) those who are members of national societies and not members of local societies; (3) those who are members of no society. There can be no question of the enormous advantage of union. That union should be completed by strengthening the existing agencies and not by the formation of new societies.

A council organized by the enlargement of the present Engineering Council can be very effective in many ways, without interfering with the autonomy of any individual society. Every society has some definite purpose of its own and also some which it holds in common with all other societies. One of the latter purposes relates to public service and to coöperation. The Council hopes that it may be successful in arousing sufficient interest to bring about a larger and better council for all engineers.

The office of the Council will be in the Engineering Building, 29 West 39th St., New York City.

General Manager of Portland Cement Association Dies

J. P. Beck, general manager of the Portland Cement Association, died in Chicago, Sept. 8, after a short illness. He was appointed to his present position a year and a half ago, at the time that the Portland Cement Association enlarged its activities. Over night, almost, its work was expanded more than five-fold, and it fell upon Mr. Beck's shoulders to create the machinery needed for the enlarged organization. That he did this unusually well is the testimony of the leading cement men of the country. His position was a difficult one. He had to satisfy the member companies, East and West, North and South, and he succeeded in this task by sheer ability, which showed in the success of his plans and administration.

Mr. Beck was graduated from the University of Illinois in 1907, and at once entered the advertising department of the Universal Portland Cement Co. Within two years he took charge of the department. His forceful personality and able handling of his work soon won him many friends and admirers in the cement industry. As a result he was asked about two years ago to draft a plan for the enlarged activities of the Association of American Portland Cement Manufacturers. This plan was presented at the annual meeting of the association, late in 1915. It was adopted and Mr. Beck appointed general manager of the renamed association to carry out the suggestions he had made. The work has developed very rapidly since that time, and instead of the one office in Philadelphia, district offices are operated in 12 cities.

In addition to his chief work Mr. Beck was for several years general manager of the Cement Products Exhibition Co., which conducts the annual Cement Show in Chicago. He also bore a leading part in the two national conferences on concrete road building.

Ouachita River Dam Fails

The drift pass and weir making up about a 150-ft. section of lock and dam No. 5 in the Ouachita River, near Monroe, La., and more than 100 ft. of the high bank on the west side of the stream were washed out Aug. 10, doing damage estimated at about $250,000. The break was probably due to the sandy bottom of the river.

The dam has been threatened on several different occasions and large sums have been spent in putting stone on the river bottom and on the bank to prevent wash. E. S. Maupin, engineer in charge of the construction of the locks and dams in the Ouachita River, gave no statement as to the future as plans will be determined by the board of engineers when they have had opportunity to estimate the damage. It is probable the site of the dam will have to be changed because of the condition of the river bank and the bed.

Cantonment Construction Nears Completion

American Contractors Equal to Great Task Put on Them by Rush of War Demands—Causes of Delay Are Local

COL. I. W. LITTELL, in charge of the cantonment construction for the United States Government, authorizes the following:

With the arrival of the first contingent of the new National Army at the cantonments Sept. 5, the status of construction at the various cantonments will undoubtedly be of public interest.

Altogether, 16 military cities have been built by the Government to house the 687,000 citizen soldiers selected for service by the draft. Of these cities, seven were ready Sept. 5 to receive their entire quota of officers and enlisted men. These seven included Camp Taylor, at Louisville, Ky.; Camp Travis, at Fort Sam Houston, Tex.; Camp Lee, at Petersburg, Va.; Camp Lewis, at American Lake, Wash.; Camp Sherman, at Chillicothe, Ohio; Camp Devens, at Ayer, Mass.; and Camp Grant, at Rockford, Illinois.

Seven Ready To Receive Officers

Seven other cantonments were ready to receive all the officers and two-thirds or more of their entire quota of enlisted men. These comprise Camp Dodge, at Des Moines, Iowa; Camp Funston, at Fort Riley, Kan.; Camp Custer, at Battle Creek, Mich.; Camp Pike, at Little Rock, Ark.; Camp Dix, at Wrightstown, N. J.; Camp Jackson, at Columbia, S. C.; Camp Gordon, at Atlanta, Georgia.

The two remaining National Army cantonments—Camp Upton, at Yaphank, L. I., and Camp Meade, at Admiral, Md.—have already received and are taking care of more than their full quota of officers and are ready to receive the number of enlisted men originally ordered there on Sept. 5.

An army of approximately 150,000 men was employed in the construction of the 16 National Army cantonments up to the first of September; since that date the force has been gradually reduced.

Certain Extra Units Not Complete

There are certain units in connection with each of the cantonments which were added after the original scheme was under way and which are, in some cases, not complete. These are general hospitals in addition to the regimental hospitals and remount stations to take care of some 12,000 horses each. The completion of these buildings will not, however, interfere with the reception of the citizen soldiers on the dates they have been ordered to report at the respective cantonments.

A typical layout such as is required for accommodating the officers and men at a cantonment comprises, in round numbers, 1500 separate buildings, requiring approximately 30,000,000 ft. of lumber.

Each cantonment requires a complete system of water-supply and sewage disposal, the piping alone for which amounts to more than 50 miles. The general warehouses, with necessary trackage, have also been provided. Where the facilities are not available in nearby cities, complete refrigerating and laundry plants have been built.

One Building Every Four Minutes

At each cantonment up to Sept. 1 it has been necessary to complete on an average of one building per hour, or for all the cantonments an average of one building every four minutes.

In the construction of the cantonments to date over 50,000 carloads of material have been transported to and delivered at the sites—an enormous tax upon the already overburdened railroad facilities of the country. The railroads, however, have given splendid service. All Government orders have received precedence and the lumber and other supplies needed have been rushed to the cantonments in record time.

The cantonments in the East have been handicapped by the fact that it has been impossible to secure sites without going away from the railroad lines and labor markets.

University Will Give Course in Public Utilities

Public utilities will be the subject of a special course of instruction by Professor Heilman at the School of Commerce, Northwestern University, Chicago, Ill. It is intended for those in the service of public-utility companies, governmental regulating bodies and financial firms; also for engineers and others interested in an understanding of the problems involved in regulation and control of utilities. The course will cover valuation, rate-making, service, operation of local utilities, financial utilities, governmental regulation and control, and the public-ownership movement.

Minneapolis Will Spend $1,000,000 for Increased Water-Supply

Minneapolis will spend $1,000,000 in new construction to increase its water-supply. Eight filter beds, four of which are under construction now, will be completed about the end of 1918. When Minneapolis began treating its water-supply from the Mississippi River by mechanical filtration, in 1913, it started with 12 filter beds. In 1915 four were added, giving a filtration capacity of 56,000,000 gal. daily. The average consumption was 30,000,000 gal. daily, but during an extended dry period in 1916 the demand crept up to 59,000,000 gal. The new filters will increase the capacity by 30,000,000 gal. F. W. Cappelen is city engineer; W. N. Jones, constructing engineer, and L. I. Birdsall is superintendent of water purification.

Strengthen U. S. Public Health Service

Bill Creating Public Health Reserve and Providing for Co-operative Health Work

The joint resolution to establish a reserve of the United States Public Health Service, passed by the Senate last June, was favorably reported to the House on Aug. 30, but with amendments to change the resolution into a bill and to enlarge its scope.

If the bill as reported is enacted, officers of state, county and municipal health organizations, with the consent of the authorities under which they serve, and also "other persons skilled in sanitary science," may volunteer as members of the Public Health Service and on recommendation of the surgeon general of the United States Health Service, and with the approval of the Secretary of the Treasury, may be commissioned by the President with grade of assistant surgeons, past assistant surgeons, surgeons or senior surgeons for four years or during the present war, in accordance with rules and regulations prescribed by the President. When ordered into service these officers shall receive the same pay as officers of corresponding grade in the Public Health Service. The duties of the reserve corps shall be "directed toward the proper sanitation of ports and places" in or within the jurisdiction of the United States, including "especially places in and near which" either industrial or military forces are or are to be mobilized.

Officers To Hold Presidential Commissions

The bill as reported contains two sections which seem to be independent of the provisions establishing a Public Health Reserve. One of these is designed to give Presidential commissions instead of Treasury appointments to any non-medical man appointed as chief of the division of chemistry, of zoölogy or of pharmacology in the Hygienic Laboratory; also to give Presidential commissions to sanitary and assistant sanitary engineers, epidemiologists and assistant epidemiologists in the Public Health Service. The other section makes it the "duty of the Public Health Service to coöperate with state, county and municipal health organizations and with officials in charge of industrial establishments, with a view to coördinating the activities and making effective the work of public-health organizations in the United States."

Chamber of Commerce to Have War Meeting

A special war meeting of the Chamber of Commerce of the United States will be held at Atlantic City, Sept. 18-21, at which time will be considered the different phases of the problem of the Government control of prices; establishment of priority in requirements of the Government and of individuals for

materials and products, the supply of which is limited; and there will be discussed the industrial relations during the war, with particular reference as to how the Government can best procure the supplies most needed for the war and how to handle the interesting problems which arise in connection therewith. This war convention is expected to give business men an opportunity of expressing their thoughts and putting in definite form the results of their experience so that they may be as helpful as possible to the Government during the present crisis.

Personal Notes

JOHN A. STEVENS, consulting engineer, Lowell, Mass., has organized a department to design and superintend the construction of factory buildings.

H. WALTER LEAVITT has been appointed testing engineer for the Maine State Highway Commission, succeeding E. D. KINGMAN. Mr. Leavitt, who was recently student assistant testing engineer in the United States Office of Public Roads and Rural Engineering, will have charge of the Highway Laboratory which is located at the University of Maine, Orono, Maine.

STANLEY DEAN, associate professor of hydraulic engineering, Armour Institute of Technology, Chicago, since June has been chief of surveys at Camp Jackson, having charge of field work on the construction at that point. He is on leave of absence from the institute until the work at Camp Jackson is completed.

HENRY WELLES DURHAM, consulting engineer, New York City, has been ordered on active duty in the Engineer Officers' Reserve Corps and has closed up his private business.

GEORGE L. CHRISTIAN, formerly assistant engineer, the Department of Public Works, Borough of Manhattan, N. Y., has accepted an appointment as deputy city engineer of Yonkers, New York.

JAMES A. F. STRYKER, formerly with the Richardson Engineering and Construction Co., Bainbridge, Ga., is at present at Lakeland, Fla., in charge of the new post office as chief engineer with the Wise Granite and Construction Co., of Richmond, Virginia.

E. J. CHAMBERLIN has resigned his position as president of the Grand Trunk Ry. and is succeeded by HOWARD G. KELLEY, vice president, whose assumption of Mr. Chamberlin's duties during the latter's absence on a three months' leave was noted in these columns under date of Aug. 2. Mr. Chamberlin was appointed president in 1912 in succession to the late CHARLES M. HAYES, who lost his life on the "Titanic," having previously held the position of vice president and general manager for two years. He was born in Lancaster, N. H., and came to Canada in 1896 as general manager of the Canada Atlantic Ry. Mr. Kelley is a native of Philadelphia and held several important positions on American railroads, becoming chief engineer of the Grand Trunk Railway System in 1907 and vice president in 1911. GEORGE C. JONES, formerly vice president and general manager of the Central Vermont Ry., has been appointed assistant to Mr. Kelley, with headquarters at Toronto. U. E. GILLEN, late general superintendent at Chicago, becomes vice president, and W. D. ROBB, vice president in charge of motive power.

CLYDE S. CONSTANT, formerly in the contracting business at Junction City, Kan., is at present employed by the Government in the sewer and water department of the new cantonment at Ft. Riley, Kansas.

H. A. HARROLD, formerly draftsman for the California Highway Commission, is at present city engineer and superintendent of streets for the City of Napa, Calif. After graduating from the University of Oregon in 1909, Mr. Harrold became rodman on construction work with the Northern Pacific Ry., and was then assistant municipal engineer for the municipality of South Vancouver, B. C., later becoming assistant engineer for Vallejo, California.

GEORGE H. HILL, formerly chief engineer of Bluefield and chief engineer of county road construction in Mercer County, West Virginia, has been appointed assistant engineer of the West Virginia State Road Commission. Mr. Hill will have charge of road matters in the Counties of Gilmer, Braxton, Clay, Webster, Nicholas, Greenbrier and Pocahontas, with headquarters at Charleston, West Virginia.

J. S. BRIGHT has accepted a position as civilian engineer with the Federal Government, with headquarters at Portland, Ore. Mr. Bright was recently resident engineer on the Tulare County, California, highway system.

W. E. FIRTH, safety engineer for the Midvale Steel Co., Nicetown, Philadelphia, has resigned.

J. E. MCALLISTER has been appointed vice president and general manager of the National Steel Car Co., of Hamilton, Ont. Mr. McAllister was formerly general manager of the British Columbia Copper Co. and has been consulting engineer to the British American Nickel Corporation.

Engineer Officers' Reserve Corps Assignments

The following-named officers of the Engineer Officers' Reserve Corps now on duty at the engineer training camp, in the vicinity of Washington, D. C., are relieved from duty at that place and will report at the proper time at the divisional training camps indicated below for duty with the engineer regiments and engineer trains of the National Army at those places:

To Ayer, Mass.

Second Lieuts. Roy E. Kistler, Gerald Marcy Keith, R. Dale Braman, Ernest J. Kluge, Morris G. Shepard, John A. Root, Joseph W. Strong, Edward F. Deacon, John F. Foley, John F. Wood, Homer N. Bartlett and Grant E. Gay.

For assignment to the Three Hundred and First Engineer train, Ayer, Mass.: Capt. Elbert W. Tompkins, First Lieut. Kingsley T. Leighton and Second Lieut. Ralph W. Reynolds.

To Yaphank, N. Y.

For assignment to the Three Hundred and Second Engineers, Yaphank, Long Island, N. Y.: Maj. John H. Watson, Capts. Frederick S. Greene, Francis W. Perry, Gilbert H. Crawford, John W. Mark, Frank A. Giesting, Alfred Renshaw, Stratford St. J. Bushman, Thomas J. Scully, Henry W. Wilson, Harry L. LaFetra and Albert R. Ullrich; First Lieuts. Ralph L. Thomas, Victor G. Thomassen, Ernest V. Amy, John W. Aitken, Madison H. Lewis, Ernest L. Robinson, Charles A. Volz, Herbert A. Philip, John H. Halfpenny, Frederick W. Weston, James E. L. O'Ryan and Thomas H. Ellet; Second Lieuts. John H. Murrin, Francis J. Sinnot, Robert O'Donnell, Leslie O. Waite, Frederick W. L. Hill and Hamilton H. Howry.

To be attached to the Three Hundred and Second Engineers, Yaphank, Long Island, N. Y.: Capts. Edward B. Simmons, James B. Martin and Allard A. Dederer; First Lieuts. Harry G. Wood, Wilbur A. Oborne, Lewis H. Harder, Frank M. Gibson, Jesse Gover, Thomas G. Townsend and Thomas T. Newbold; Second Lieuts. Frank E. Edebohls, Everett H. Pierson, Howard A. Darrin and Frank P. Reilly.

For assignment to the Three Hundred and Second Engineers train, Yaphank, Long Island, N. Y.: Capt. Harry B. Per-Lee; First Lieuts. Samuel Gatalick, Jr., and Leslie C. Millar; Second Lieut. James A. Ryan.

To be attached to the Three Hundred and Third Engineer train, Yaphank, Long Island, N. Y.: First Lieut. Walter J. McGraw, Second Lieut. Frank Hammel.

To Wrightstown, N. J.

For assignment to the Three Hundred and Third Engineers, Wrightstown, N. J.: Majs. John P. Doyle and Ora M. Leland; Capts. Roy W. Gausmann, Bertram I. Hall, John D. Groves, Robert A. Greenfield, George A. Noska, George J. F. Carey, Ernest D. Hendricks, William J. Judge and Arthur G. Bouton.

Further assignments will be noted in next week's issue.

E. W. M. JAMES, of Winnipeg, has been appointed bridge engineer for the Road Commission of Manitoba.

W. R. HOLWAY, formerly assistant engineer, Providence (R. I.) Water-Supply Board, has accepted the position as sanitary engineer of the water-purification plant and sewage-disposal works of Alliance, Ohio.

MISS ESTHER JACK has been appointed city engineer of Williston, N. D., to succeed CAPT. E. R. EVANS, who has been called into the Federal service. Miss Jack is the first woman to graduate from the engineering department of the State University of North Dakota.

CLARENCE E. RAYNOR, formerly assistant engineer in the valuation department of the Seaboard Air Line Railway Co., at Norfolk, Va., has been appointed senior highway engineer, Office of Public Roads and Rural Engineering.

BUSINESS NEWS

Has Purchased the Business of the Sarco Company

The Standard Asphalt and Refining Co., of Chicago, Ill., has purchased the plants, trade marks and goodwill of the Sarco Petroleum Products Co. The Cities Service Co., of 60 Wall St., New York City, is the new interest in back of this company, although the management remains essentially the same as before the change.

Charles Muller, who was an executive of the former company, now becomes manager. He has been associated with the old company for 10 years and has risen through the ranks to his present position and is well known in business and financial circles in Chicago. Robert F. Trumbull has been promoted to manager of the railway and building materials department. He has been in the service of the old company for eight years in this department. By constant contact with the trade during that time he is intimately acquainted with its requirements for asphalt materials.

The indications are that the new company will be much more active than the old and that its facilities for serving the trade will be greatly increased due to the extensive control of crude materials possessed by the Cities Service Company.

Brick and Tile Products Show Large Increase

Large increases in the value of brick and tile made in the United States in 1916 are reported to the United States Geological Survey, Department of the Interior. The total output amounted to $159,042,849, an increase of $33,248,005, or more than 26% over the figures for 1915. The value of every variety of product classified by the Geological Survey except two was increased. Common brick, the product of greatest value, the output of which has been declining in recent years, showed a large increase in both quantity and value.

There were 7,394,202,000 brick reported for 1916, valued at $49,357,411, or $6.68 per thousand, an increase in quantity of 543,103,000 brick and in value of $7,212,119, or 17%. Fire brick, valued at $30,806,129, increased $11,966,198, or 64%. Sewer pipe, which showed a large decrease in 1915, rallied in 1916 and showed a large increase. Its value in 1916 was $13,577,006, an increase of $2,317,657, or 21%. Vitrified brick or block remained practically stationary, being valued at $12,236,890, an increase of only $5991 over 1915. The front brick industry showed a considerable gain, its output being valued at $11,464,614, an increase of $1,929,078, or 20%. Drain tile and architectural terra cotta also showed a large increase over 1915. Tile (not drain) valued at $6,475,464—consisting of roofing tile ($914,240), floor tile ($1,438,231), ceramic mosaic tile ($1,308,861), faience tile ($814,077), and wall tile ($2,000,055)—showed a gain of $1,289,409, or 25 per cent.

Brick and tile products are classified naturally into three divisions, (1) structural materials, (2) engineering and refractory products, and (3) miscellaneous wares. The first, structural materials, including building brick of all kinds, terra cotta, fireproofing and tile (not drain) was valued at $84,643,252 in 1916, an increase of $14,234,136, or 20% over 1915; the second, engineering and refractory products, consisting of vitrified drain tile (used principally for paving), sewer pipe, stove lining and fire brick, were valued at $67,305,448, an increase of $15,636,664, or 30%, over 1915; the third, miscellaneous wares, consisting of such products as adobes, assay supplies, burnt clay ballast, chemical brick and tile, chimney pipes, tops, conduits, glass house pots and supplies, retorts, sewer block and wall coping, were valued at $7,094,149, an increase of $3,377,205, or 91%, over 1915.

Pennsylvania was the leading state in the production of brick and tile, reporting these wares to the value of $29,630,563, or 19% of the total, an increase of $8,732,281 over 1915. Pennsylvania's principal brick and tile product in 1916 was fire brick, valued at $15,200,354, which was nearly 50% of the total value of fire brick for the entire county. This was an increase of $6,111,404 over 1915. Ohio ranked second, with products valued at $25,506,344, or 16% of the total, an increase of $4,596,502. Ohio's principal brick and tile product in 1916 was sewer pipe, valued at $5,132,810, an increase of $1,413,020 over 1915. Illinois was third, with products valued at $16,507,845, an increase of $2,664,799 over 1915. Illinois' principal brick and tile product in 1916 was common brick, of which it was the leading producer, its output being valued at $6,738,152, a decrease of $132,838 from 1915. New Jersey was fourth and New York fifth, with products valued at $9,749,524 and $8,410,340 respectively, both states showing large increase in value compared with 1915.

Notes from

MAKERS OF PLANT AND EQUIPMENT

The Armco Iron Culvert and Flume Manufacturers' Association, of Middletown, Ohio, is supplying a large quantity of corrugated pipe for culverts under the new highway which connects the east and west coasts of Florida.

The route is known as the Tamiami Trail and extends from Tampa to Miami. The drainage of the great swamp crossed by this road will, it is believed, proceed rapidly under the authorization recently granted by the Florida legislature.

The Merchant Shipbuilding Corporation announces the following organization, effective Aug. 10: Chairman board of directors, W. A. Harriman, New York; president, R. H. M. Robinson, New York; vice president and comptroller, C. B. Seger, New York; vice president, C. W. Hamilton, New York; general manager, W. T. Smith, Philadelphia; consulting engineer, C. P. M. Jack, Philadelphia; engineering manager, Max Willemstyn, Philadelphia. This company is about to undertake the construction of 40 ships at its plant at Bristol, Penn., agents for the Emergency Fleet Corporation.

Chester H. Lehman, for the past six years secretary and director of the Blaw-Knox Co., Pittsburgh, has entered the service of the United States Government for the duration of the war as first lieutenant of ordnance.

The Asbestos Protected Metal Co., of Pittsburgh, announces the appointment of C. A. Crowe, formerly manager of the Grand Rapids office, to take charge of the Detroit office, located in the Penobscot Building. M. W. Taber, formerly Detroit manager, has been appointed factory manager.

The Warwick Steel and Iron Breaking Co., Inc., of Philadelphia, has recently been incorporated with Frank Dallett, president and treasurer; C. C. Bland, vice president and manager; and F. A. Dutton, secretary. The plant at Warwick, Penn., is designed to break large and unwieldy pieces of iron and steel. The company also intends to handle scrap of all kinds and dismantling projects of any size.

The Erickson Engineering Co. was recently organized by C. J. Erickson, of the Erickson Construction Co., Downs Block, Seattle. The company will engage in the construction of ships, having already established a plant on the Dumwamish Waterway in Seattle. Other incorporators are: C. E. Erickson and Charles M. Barnett. Capitalization is $2,100,000.

The Maritimo Coating Corporation, formerly located at 1733 Grand Central Terminal, is removing from the present quarters to more commodious ones at 2 Rector St., New York City. At a regular monthly meeting of the board of directors of this corporation, the following changes were made: Charles King, of the firm of Tams, Lemoine & Crane, marine architects, was elected president in the place of J. Willoughby Mitchell, resigned; L. B. Stoddart was elected treasurer in the place of C. A. Richards, whose duties in connection with the United States Bureau of Exports require his entire attention.

APPLIANCES AND MATERIALS

Steam-Jacketed Centrifugal Pumps Asphalt

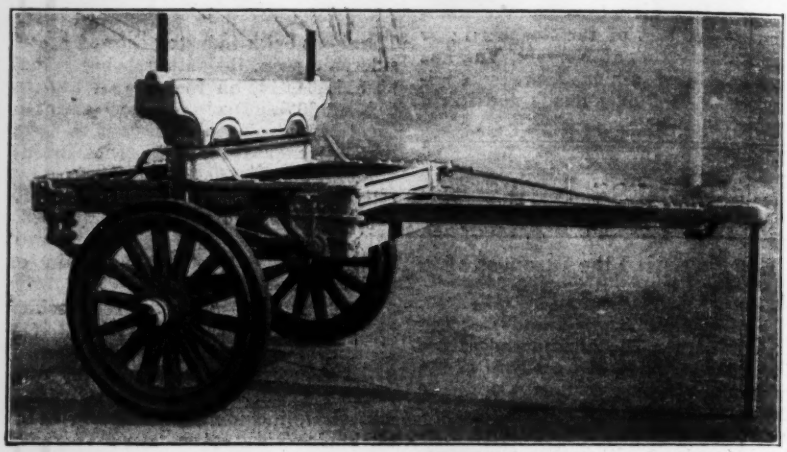
A novelty in centrifugal pumps is the steam-jacketed unit being put out by Hetherington & Berner, of Indianapolis, for handling asphalt which carries a considerable proportion of mineral matter which it is not desired to remove. With this pump it is unnecessary to watch out for foreign substances such as nails, pebbles, splinters, etc. The pump is mounted on the same base with a small steam engine taking steam from the same boiler plant which supplies the rest of the asphalt outfit.

New Goggles Give Sure Protection

A new type of safety goggles for protecting the eyes of workmen from flying particles, dust, heat, light or injurious gases has been put out by Strauss & Buegeleisen, 37 Warren St., New York City. The special feature consists in making the lenses of two layers of optical glass with a layer of celluloid interposed, the whole being "welded" together. This gives a lens which, it is claimed, has every protection which either plain glass or celluloid alone gives: That is, it is not affected by water, heat or cold and the goggles will not cloud up with moisture, since the celluloid acts as heat insulation; it can be broken as by a hammer blow and no splinters will fly; cracked lenses are gas and watertight. These goggles have been adopted by the United States Army for aviators and the lenses for gas masks.

Truck Trailer Swivels Under Load of Long Pipe

Motor-truck transportation of long pipes, well casing and other similar articles in the Oklahoma oil fields is facilitated by the use of a special two-wheel trailer shown in the accompanying view. The steel frame is mounted by long semi-elliptic plate springs on a steel axle having artillery-type wheels with 4-in. solid rubber tires 36 in. in diameter.



TRAILER HAS PIVOTED BOLSTER TO CARRY LONG PIPES AND TIMBERS

One feature is the pivoted bolster which carries the load and which allows the trailer to swivel beneath it in making turns or passing curves. A similar bolster is carried by the motor truck or tractor. Another feature is the drawbar, which is adjustable to suit the load and can be extended to a maximum length of 14 ft. This trailer truck was devised and built by the Warner Manufacturing Co., of Beloit, Wis., and over 75 of the trailers are now in use in the oil fields.

An Automatic Starter Made for Induction Motors

An automatic compensator for induction motors, enabling the remote or push-button control on this type of drive, has been developed by the Electric Controller and Manufacturing Co. of Cleveland. It can be installed by any ordinary electrician and operated by any workman or machine operator. This new device starts induction motors in the same way that the hand starters do—imposing on the motor a reduced voltage from a compensating transformer at first, and quickly substituting full line voltage as the speed comes up.

The mechanism is built as a mechanical unit that slips into a cast-iron casing and is submerged in oil. A cover bolts on and the motor, line and control leads come out like those on an ordinary transformer. The mechanism includes a small transformer, a large magnet for establishing the transformer connections, and a relay which trips a spring mechanism for throwing full voltage on the motor. When the external supply is cut off the operating magnet goes dead, and the motor is immediately disconnected from the line. Under such conditions the starter contacts resume their initial position. The same action results when the operating-magnet circuit is opened for motor control, this control being secured by opening or closing the control-magnet circuit through a special circuit. Low-voltage and overload release can be obtained from relays mounted on a separate panel and connected into the remote-control line.

Henry Ford Produces a Motor Truck for $600

Great interest attaches to the announcement that the Ford Motor Co., of Detroit, is now ready for the commercial production of one-ton trucks which are Ford machines from end to end, and not adapted pleasure cars. But there is, of course, a certain similarity to the familiar Model T.

The engine, hood, planetary-gear system, clutch, front axle, front wheels, steering gear and lighting system are the same as on the pleasure car. The side members of the chassis are heavier. The wheel base is 123 in. and the rear wheels have 32 x 3-in. solid tires. The rear axle is modified for worm drive, but there is otherwise a general resemblance to the familiar Ford type. Propulsion stresses are taken by radius rods with pivot connections at the outer ends of the rear axle. The rear springs are of the familiar transverse type, but heavier than employed on the pleasure car. The sale price at Ford agencies is to be $600.